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The Engineering Record in 1916

WITH this issue the Engineering Record enters its seventy-third volume. To its readers the editors cannot refrain from expressing their gratitude for the support and encouragement they have received. Without that stimulus the journal could not have reached its present level, and upon the continuance of the co-operation of its enthusiastic, responsive clientele, the editors rest their hope of being of still greater service to the field during 1916 and in the years to come. With this volume few changes are made. The editors feel that for the present the field can better be served by developing present departments than by establishing new ones. Of present features, special stress will be placed on the "Hints to the Contractor" pages—a section established only a year ago, yet already strongly intrenched with the contractors and rapidly becoming a storehouse of money-saving ideas. The news section will continue its rapid development, that it may deserve to hold its characterization as the engineers' and the contractors' newspaper. The technical pages will maintain their reputation for intrinsic value, accuracy and definiteness—the last a trait that has received special commendation—while the editorials will speak freely and illuminatingly on the issues that concern the engineer and the contractor. Finally, the journal will continue to be thoroughly representative of the clientele it serves—energetic and vigorous, enthusiastic for all that is sound, just and of service to its field. It would not deserve well of its readers if it promised anything less.

Review of the Year

DEPARTING from the custom established two years ago, the Engineering Record, instead of publishing signed retrospects and prospects, presents in this, the first number of the new year, a series of editorial reviews. Believing that the annual advances in most fields, taken in their entirety, are exceedingly small, those particular features have been selected for discussion which clearly represent important advances. Fields or specialties in which there has been no progress of note have not been touched upon. The reader will find in these pages, therefore, a presentation of only the outstanding features of the past year's development. Figures as to volume of work, while interesting, are likely to mar the perspective. They have, therefore, been avoided. The main issues are briefly presented, their strong points thrown into relief, so that a correct view of the present status of the field may be quickly secured.

Year's Feature in Paving Practice

IN SPITE of the fact that construction activities in the highway field during 1915 were not curtailed by the war to the same degree as in other lines of engineering, there was but one development which indicated an important change in the standard practice of former years. This was the rise to favor of the monolithic type of brick pavement, in which a thin mortar bed, instead of a sand cushion, is used, and in which the blocks are laid before the concrete base has hardened. The subject has been treated at length in articles and editorials in this journal, and there is no need, therefore, of describing the details of construction. While engineers are not in entire agreement as to the wisdom of discarding the sand cushion, the new type has such intrinsic merits that its rapid spread is certain. Moreover, as pointed out in this journal Oct. 9, 1915, pages 453 to 456, the new method, so far at least as the mortar bed is concerned, is not entirely new. To its intrinsic merits is added the argument of good service—and what indorses a mortar bed still more strongly indorses the monolithic type. It is being more and more recognized that the chief cause of the failure of brick pavements, outside the use of poor filler, is a cushion which shrinks unequally and is subject to displacement. It is true that if a surface is absolutely waterproof there should be but little trouble from displacement, but investigations, previously reported in this journal, indicate that the shrinkage of the sand, due to unequal moisture content and variations in thickness of the cushion, are chiefly responsible for the hollow spots, which are points of weakness and are first to break down. This shrinkage, obviously, is eliminated by the mortar cushion. It may confidentally be expected, therefore, that the new type will quickly gain in favor. Certainly experience with its nearest neighbor in design—the mortar bed pavement—gives warrant for believing that the new construction will prove a success.

Advance in Timber Specifications

TWO YEARS ago a paper presented by Mr. Hoxie before the American Society of Mechanical Engineers started a vigorous discussion regarding the quality of structural timbers and specifications under which they are purchased. This discussion developed into an agitation for securing better conditions in the structural timber business, and that agitation developed with such rapidity that within two years' time timber has taken a new place in the minds of those who are particular about the materials they use and the specifications under which they are purchased. Briefly put, the density specification for buying structural timber now rules the timber field. Not only has it received the backing of the engineers, as evidenced in its adoption by the American Society for Testing Materials and its advocacy by the U. S. Forest Service, but producers have indorsed and adopted it as their standard. The Yellow Pine Manufacturers' Association, through its board of directors, adopted the rule a year and a half ago, while within a few months the Southern Pine Association, which will have a great influence on the lumber market, has accepted the specifications of the American Society for Testing Materials as the standard for its members. The action of the latter association is particularly commendable. It strikes right at the root of the whole question. If the producer can be induced to accept the proper specification, and will take the still farther step of branding his material so that responsibility for it is definitely and surely fixed, the battle will be won. That there was great need for reform for timber purchasing none who has had experience with the lumber market will deny. That the reform, however, has come within two years is a tribute to the influence of the engineers who have advocated the change and to the producers, such as those in the Yellow Pine Manufacturers' Association and the Southern Pine Association, who have been open-minded enough to see the correctness of the engineers' stand and have determined to co-operate with them.

Concrete Progress

CONCRETE progress during 1915 lay chiefly in a keener appreciation of the relation which mixing and handling methods bear to the quality of their product. It has been known for years that short mixing periods, spouting of wet concrete, carting over long distances, etc., tend toward a non-uniform and unsatisfactory concrete. Appreciation of these facts, however, to the extent of allowing them to have an influence upon methods of construction, was confined very largely to the engineers. Contractors recognized them, but passed them off with the remark that concrete on the whole is good and that these methods have a comparatively small bearing on the end and result. Now, however, even among contractors the evils of improper mixing and handling methods are being appreciated. Indeed, mixer manufacturers are changing their selling arguments to conform with what the engineers enunciate as good concrete-mixing and handling practice. Specifically, there are strong movements in favor of longer mixing and against the use of spouting. The remedy on the one hand is very easy—to keep the material in the drum longer. This will cut down production, of course, and Nathan C. Johnson has therefore proposed that the grout be mixed in a preliminary operation and then incorporated with the larger aggregate. In the matter of spouting, too, the difficulties are not insurmountable, though the opinion is gaining strength that it is practically impossible to enforce proper conditions. If this feeling grows and contractors fail to take the necessary precautions, one can expect engineers to forbid spouting methods to be used on their work. Certainly the present feeling against poor mixing and improper handling of spouting will not, and should not, down till better methods are enforced.

Highways Lead in Activity

JUST as in 1914, the most active branch of engineering during the year just closed was the highway field. Statistics gathered by the Office of Public Roads indicate that $240,000,000 were spent upon new construction. Estimates so far made indicate that approximately $270,000,000 will be spent in 1916. Moreover, the growth in local highway associations and the interest taken by all classes of citizens is steadily increasing, so that one can safely expect still larger appropriations in future years. While this activity is highly commendable, on account of the tremendous economic influence of better roads, it is regrettable that funds for maintenance do not seem to keep pace with those appropriated for new work. It is unnecessary to impress upon engineers the need for proper maintenance. Laymen road officials, on the other hand, sorely need education on this matter, and it is the plain duty of every highway official of technical training and experience to do all in his power to impress the need of adequate maintenance funds on the laymen officials with whom he is associated. Continuance of the policy of allowing roads to go to pieces before they are given repair attention means a large financial loss to the community and very great inconvenience during the period when the road is in bad condition. As far as highway construction is concerned, it is particularly notable that within the last two years many large contracting firms, with long experience and excellent organizations, have engaged in the work. This has been due to lack of contracts in other lines. With the resumption of normal activity, work for them will probably be found in the fields where they originally operated. It is quite certain that having gained the experience and purchased the needed plant they are quite likely to stay in highway work. Needless to say, this is an advantage to the public, for the larger organization as a rule can be relied upon to do better work and to operate at lower cost. The situation, therefore, in the field is most encouraging. If the one unsatisfactory condition, the failure to give maintenance its proper place, is corrected engineers will be able to look with still greater complacence upon the wonderful strides which have been made for better roads and pavements.

The Business Situation

FINANCIALLY the past year presented the unusual condition of a plentiful supply of money with everyone afraid to invest it in anything from which an immediate return was not in sight. No one knew during its early months how the European war would affect our economic structure, and because of lack of confidence in the future stability of business projects for which the funds had not already been provided were unable to procure backing. Curiously enough, one of the first influences which set to work to restore confidence was the war itself. Foreign nations came to us to buy, first steel and munitions, then everything we could sell. Exports grew by leaps and bounds, records were broken every week, and in spite of imports in nearly normal volume, a balance of trade piled up in our favor which threatened seriously to affect foreign credit. Fortunately the situation was adjusted before any harm was done. It soon became evident, however, that instead of needing every cent our bankers could scrape to pay back the tremendous debt of foreign-held American securities, we were able to pay for them in goods, and to go yet further and shift the gold movement in our favor by half a billion dollars.

This money had to have outlet. It could not lie idle; yet it was, and to some extent is yet, chary of private enterprise. The credit of our governmental bodies, however, had weathered the first shock of the war unshaken, and the investor naturally turned to municipal, county and state bonds. Little wonder that sales of municipal bonds for the eight months ending with August exceeded those of any like period in our history, and that the total value of municipal bonds issued during the ten months ended with October have threatened the previous high record. All this meant public work —a new capitol for Oklahoma, new municipal buildings in Detroit, large school construction programs for practically all of our leading cities, and city, county and state road improvements in extraordinary volume. Waterworks, sewers, and other municipal work lagged somewhat behind, but still came in for a nearly normal share of funds.

Privately-financed construction, except in the steel industry and elsewhere when immediate returns from export trade were in sight, have scarcely yet begun to follow the lead of public work. The steel industry itself, generally an excellent index to conditions, has run far ahead of its usual place because of favoring circumstances. Its present status, perhaps the best in its history, is due to increased exports of steel products, which brought up prices and brought out domestic buying on a tremendous scale. The size of the latter movement can be appreciated when the present railroad buying is contrasted with the rigid economy in equipment practised for the past two years. Another large factor in this buying movement was the low point to which stocks of all sorts of steel had been reduced by the warehouses. With the steel industry's expansion came gains in railway earnings, first due to export movement and then to the handling of record crops. This improvement itself, aided by two small rate increases, reacted again in favor of the steel business.

Under the circumstances, it could hardly have been expected that large construction contracts would be as numerous as in past years. However, more than one hundred contracts ranging from $500,000 up have been reported as let in the columns of this journal. New York, Philadelphia and Boston rapid-transit contracts form a large part of the total. The remaining projects are scattered, including industrial plants, terminals, drydocks, two government locks, sections of the Calumet-Sag channel at Chicago, a few large railroad contracts and a good number of big buildings. Bridge work, of course, was slack, as it usually lags behind other work except in periods of expansion. Nevertheless, at least twenty-five contracts amounting to $100,000 or more were reported.

In the past two months the gain in business has broadened to a country-wide basis, and depends no longer for its maintenance on foreign trade. Construction work does not measure the actual improvement at present, however, because of the lateness of the season, but prospective work which seems destined to go through with the opening of the spring of 1916 promises substantial gains over the present year in every respect. If the rising prices in construction materials, such as cement and lumber, may be interpreted as in normal times, the contractors are going to have a busy season after the lean years. These rising prices, of course, will mean higher construction costs, while labor also is sure to be high. In fact labor shortage may actually curtail the execution of works now confidently planned. This is a matter with which contractors must reckon in preparing bids for the new year's work.

The danger to our market from increased cost of production, which will make it hard for us to meet foreign competition after the war, even in our own country, still exists. However, this danger is realized on all hands, business is preparing to meet it, and it is hoped that Congress will render material aid by passing the necessary legislation. If this, the one cloud on the horizon, dissolves, the country will come into a period of great expansion on a sounder basis and on a much larger scale than such expansion has ever had before.

War and Waterworks Chemicals

IN WATER PURIFICATION the outstanding feature of the year has not been any new technical development, but a commercial situation arising out of the European war. The cost of the chemicals usually employed in purification work has gone up enormously, thus increasing filter operating costs and directing the attention of investigators toward new sources of chemical supplies. Alum, for example, is now quoted at from $40 to $50 per ton, more than double former prices, while soda ash has advanced from $14 or $15 to $30. Even at the higher figures it is almost impossible to secure sufficient quantities. The rise in the price of hypochlorite has been equally sensational, for the large amounts imported in normal times have been cut off by military operations. Whereas $37 per ton was quite an ordinary figure before the war, now $90 to $100 per ton must be paid. Curiously, however, the price on liquid chlorine has not risen, though primarily the materials come from the same source. From $8 to $10 per hundred pounds is the present quotation on the liquid article. As a consequence many large plants formerly using hypochlorite have recently been changed over so as to use the liquid form.

Lime has not advanced and there seems to be no reason for raising the price, although increased demands by the broadening building activity may operate to that end later on. In any event, however, the increase in price is not apt to be serious. Sulphate of iron has remained at the former figure.

In the minor chemical supplies, those for laboratory uses, the advances have been from fifty to several hundred per cent.

Apparently, however, the war and the price consequences have not been without compensation. This journal has already had the privilege of recording what has been done at Columbus. In the issue of May 8, page 576, an alum plant established by the city was described. Reports now show that it has proved its case, the average cost of producing 648 tons of alum from January to September, inclusive, being $7.38 per ton, representing a saving of $6,000 over the market price of the material. This cost, however, does not include interest on investment and plant depreciation, so that the saving must be taken with appropriate allowance. At Columbus, too, still further experimentation has been going on. When it was found that the price of sulphuric acid had gone up very materially over the 1915 contract price of $12.50 per ton, an experimental acid plant was set up and preliminary runs thus far made indicate that the acid can probably be produced at a cost not to exceed $10 per ton.

It is not safe to predict what may happen in this local development of chemicals for water purification use, but if conditions in the chemical industry following the war prove to be unsatisfactory, and chemical manufacture becomes a regular part of water-plant operations, operators of such installations will have before them still greater technical responsibility than at present. Theoretically, of course, the assumption of a wide variety of duties by an organization fashioned for one particular class of work does not lead to efficiency. Consequently, whatever is done now along the lines being pursued at Columbus must await for final judgment the return of normal times. Nevertheless, it is gratifying to see that engineers engaged in this line are fully competent to cope with situations when emergencies arise.

Engineers' Response to Call for Military Preparedness

WITH the passing of the year 1915 a new engineering movement has been born—a mobilization of the country's technical resources as a measure of defense in the event of war. Until very recently, engineers were inclined to regard military preparedness merely as a general term with which they had no professional connection—in the same category as the tariff and methods of taxation. In other words, they felt that it was one of many subjects with which all good citizens should be familiar if only they had time to gain more than a superficial understanding of its meaning.

Within the last few months, however, there has been a decided change in the attitude of technical men toward national defense. The European conflict has demonstrated that modern warfare is, very largely, a matter of engineering, and that in the event of a threatened invasion by foreign forces this country would have to place a heavy burden of responsibility upon the engineering profession. To equip its members to discharge this responsibility is now the aim of the profession at large.

In the Corps of Engineers of the U. S. Army on Oct. 1 there were 230 officers. In case of attack by a foreign power thousands more would be needed. Where is the supply coming from? This is the question which has set technical men thinking, and as its import is being grasped, a great wave of interest is sweeping over the country, and at every turn there are evidences of the engineer's eagerness to play his part in any plan of national defense that Congress may adopt.

There was little real progress as to ways and means until late in the year just passed, yet much has been accomplished. Five of the national engineering societies—civil, mechanical, electrical, mining and consulting—through a joint committee headed by William Barclay Parsons, have co-operated with the War Department and members of Congress in the drafting of a tentative bill creating a reserve corps of engineer officers. The object of the measure is to provide means, by intensive training at summer camps and by correspondence courses, for the engineer in civil life to familiarize himself in some measure with military duties. Of course, a seasoned soldier cannot be made by a month's training. This is not to be expected. But a man who wants to learn can absorb a great deal at camp. Should there even be a call to arms the time needed to develop capable engineer officers would be very considerably reduced if the men had previously been grounded in the elements of the duties they would be called upon to perform.

But engineers have gone further than this. There is a manifest desire for results even without waiting for Congress to announce a definite program, and local engineering societies in the larger cities are planning for courses of military instruction this winter. City engineering departments also are displaying keen interest in the subject, and although no actual courses of military training have been begun by engineering organizations, so far as the Engineering Record knows, there is every probability of such action in the near future. Of course, a number of engineers attended training camps like the one at Plattsburg last summer.

Then, too, there are the contractor and the manufacturer of engineering equipment. Each is a vital factor in the defense program. A plan of organizing the manufacturers of the country, so as to eliminate lost motion and red tape in turning out supplies for the government's use, has been suggested. Its chief features were discussed in the Engineering Record of Nov. 13, page 589.

This, then, is the status of the engineer's activities in preparedness: He realizes that it is his job; he wants to learn more about it; and has taken the first steps toward acquiring this knowledge. A study of texts on military engineering will show how well the civil engineer is trained to take up the tasks that fall to the army engineer. Surveying, mapping, laying out defenses, camps and railroad lines; the building of water-supply systems and of sanitary works; the construction of fortifications, the driving of tunnels and the placing of mines; the building of bridges and roads—all are included in the military engineer's work. To the engineer in civil life much of this has a familiar ring. It all seems like part of the day's work. But the engineer who would be useful in war must be a soldier first of all, and this means military training and plenty of it. He must reconstruct his views as to methods of doing things in the field. Economy must give way to speed. Quick results are what count. These and scores of other things he must learn and he must learn them now. He cannot learn them so well at the eleventh hour, nor with such advantage to the country. No one appreciates this fact better than the technical man, for advance planning and organization are the very essence of his work. Unless all indications miscarry, the present year will see something definite accomplished in the matter of preparedness, and if a call should come the country's engineers will not be found wanting.

Progress in Society Co-Operation and Publicity

THE INCEPTION, both as to time and place, of significant movements is often difficult to trace. Generally the beginnings are small and no single individual bears the whole responsibility. In fact, if the movement be truly important, both in its object and the vigor with which it proceeds, it is likely to have been in the minds of many persons, more or less definitely, for some time. Expression from one quarter has then been met with response from others, and almost without effort minds become prepared for action.

It would be difficult to trace the present movement for improving the status of the engineer back to its inception. It has been in evidence for some time, though its recent vigor indicates that new relations have been discovered and that new minds are at work on the problem. Certainly the interest in the engineer's status was never keener nor so broad. From the top of the profession even to the bottom the question is discussed, even though the motive be different. In the higher ranks pride in the profession and solicitude for the engineer's standing are the stimuli; among the younger men, the relatively unsatisfactory scale of remuneration.

And though the stimuli are different, the remedies proposed are, in part, the same. Both classes see the need of better co-operation and proper publicity. The first class advocates co-operation in order that a stronger body may stand before the public in advocacy of plans or policies that received professional indorsement; the other, that employment may more readily be found and that compensation may be increased by fitting men to the right jobs. For both ends publicity is deemed to be a necessary agent. And because interest is found from top to bottom and society co-operation is suggested most commonly as the means for accomplishing desired results, one may safely conclude that engineering societies have been acquiring strength rapidly. Such, indeed, is the case, and while it may not be said that epochal steps were taken in 1915, certainly the growth of the movement in breadth and depth was notable and evident.

Nationally various events tended to bring the big engineering societies together. Early in the year Mr. Swasey made his gift of $200,000 for the establishment of the Engineering Foundation, in the direction of which the four leading national engineering societies participate. Then came the important work in New York State of formulating the views of engineers upon desirable revisions of the New York State Constitution, a work again in which all of the national societies, and a number of New York local bodies, participated. Upon the heels of that work followed the International Engineering Congress at San Francisco. Naturally these instances, where it was plain that the best results could be accomplished by bringing all branches of the profession together, have indicated the need of a more constant co-operation. As a result there have been a number of suggestions that some permanent and continuing basis be arranged, and at the International Engineering Congress it was clearly indicated by a number of speakers that plans for such co-operation are under consideration.

And while consciousness of the need for co-operation nationally has been growing, the advantages of closer relations between local bodies have been becoming apparent to a greater and greater number of men. A movement to bring together local branches of the national societies is in full swing. In relatively few cases has the co-operation been fully worked out, though there are conspicuous examples of success. In a number of large centers, Chicago and Cleveland among them, the matter has been under advisement, and it would be surprising, indeed, if the new year did not witness the consummation of some of the plans. At St. Louis, as is well known, the co-operative work has been carried on with success for some years, while the triumph—and the word is advisedly used—of the Philadelphia Engineers' Club in its great campaign for membership has attracted the attention of the entire profession. That campaign grew out of a plan of local-branch co-operation.

Another phase that must be reckoned with in the future development of professional organization is the movement started at Chicago to bring together the younger and lower paid members of the profession. The Associated Technical Men and the American Association of Engineers have been criticised as attempts to unionize the profession. To dismiss these organizations, however, with such a characterization is not only to do them an injustice but to close one's eyes to certain needs which must be provided for. Provisions for an employment exchange and for aiding in local legislation are proper functions of a professional organization, and these seem to be the leading objects of the associations in question. It is properly contended that these objects could be satisfactorily handled by existing local and national societies. These bodies, however, have not taken care of these matters, and until they do one can safely look for an increase of membership of the Chicago organizations.

Insofar as publicity for engineering matters is concerned, the movement in full swing during 1913 and 1914 has gathered greater force. The antagonism to publicity, due to mistaken ideas as to its purposes and means, is rapidly disappearing, and few engineers will now contend, if good taste be not violated, that publicity for engineering plans or movements of public moment is undesirable or improper. The conspicuous position of the Cleveland Engineering Society, due to its excellent publicity work, has often been commented upon. Its signal success, however, has now been eclipsed by the wonderfully successful campaign which quadrupled the membership of the Philadelphia Engineers' Club, making it the largest local engineering organization in the United States. Such successes as these, enhancing the society's standing in its community without lowering its dignity, will go far in establishing publicity methods as a legitimate agency in advancing the engineer's position in public life.

It is apparent, therefore, that in the profession as a whole the determination is clear to marshal the forces and to fit the engineering societies to serve better their members and the profession. Nationally and locally the societies are strong. They need now to be massed, to be co-ordinated, to be inter-organized for effective work. At the top it means closer co-operation between the national bodies. On another plane, serving an entirely different but most important purpose, will come co-operation and co-ordination between the local engineering societies in each of the large cities. With such a massing of forces, unified action on important matters will be relatively easy to secure. The channels of communication will be properly established and plans can be made broadly with certainty that the machinery for carrying them out can be promptly and effectively put into action. This is a consummation "devoutly to be wished." It is not, in this time of professional readiness for action, an idle dream, an impossible project. On the contrary, with interest at white heat, it is fairly easy of accomplishment. Forces are stirring, plans are under way; good-will and the spirit of compromise were never in more evidence. What a step might not be recorded in American engineering history if the close of the year 1916 should find the entire profession welded together, unified for all action tending toward professional advancement?

Activated-Sludge Sewage Treatment

THE MOST interesting and promising sanitary engineering development of the past year has been the activated-sludge method of sewage treatment. More enthusiasm has been occasioned by it than by any other development since the Imhoff tank.

The fundamental idea connected with the activated-sludge method was first worked out in Manchester, England, in 1914, by Messrs. Ardern and Lockett, under the inspiration of Professor Fowler, of the University of Manchester. The English experiments prior to the awakening of interest in the problem in this country were outlined in the Engineering Record on March 6 last, page 288. These English experiments had demonstrated the "operative" success of the process on the fill-and-draw plan, both on a laboratory and on a larger out-door scale. They had not demonstrated its economic success.

In this country the first experimental work, also on the fill-and-draw plan, was done by Professor Bartow, of the University of Illinois. A little later the Milwaukee Sewerage Commission began to experiment with the fill-and-draw plan. In December, 1914, paper studies of the method were made at the Hygienic Laboratory of the U. S. Public Health Service and plans devised whereby the fill-and-draw process might be translated to the continuous-flow process. A patent was granted to the service in May, 1915, covering these paper studies. The patent gives two fundamental designs for the continuous flow process: (1) a method, involving oxidation and settling chambers, in which the activated sludge is returned by gravity through a communicating slot into the oxidation chamber; and (2) a method, involving oxidation and settling chambers, in which the activated sludge is returned by pumps or other propelling means from the settling into the oxidation chamber. Joint experiments between the Health Service and the Baltimore Sewerage Commission were begun at Baltimore on the first of these two methods, as it appeared to be comparatively inexpensive to convert one of the new Imhoff tanks at Baltimore for the purpose. Unfortunately money shortage is delaying these experiments considerably.

In the meantime the second of the two methods given in the health service patent was worked out independently at Milwaukee and experiments thereon begun. T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, read a paper at Dayton, Ohio, in October in which he outlined some of the results of these experiments. The outstanding point made in this paper was that it seemed possible, under the conditions obtaining at Milwaukee, to purify the sewage of that city in summer weather by the continuous-flow activated-sludge process at a cost of about $5 per million gallons, exclusive of sludge-treatment costs. This figure was apparently based upon the ability to manufacture power at ⅝ to ¾ cents per kilowatt hour. Incidentally, it should be recorded that the first activated-sludge tanks to be put in service in this country are nearing completion under Mr. Hatton's direction at Milwaukee.

Activated-sludge experiments are being conducted at a great many other places in this country. Brooklyn experimented on a small scale with the fill-and-draw method and with the first of the two methods given in the Public Health Service patent. A paper upon these experiments was read by W. T. Carpenter at Lakewood, N. J., on Dec. 3, before the New Jersey Sanitary Association. Apparently none of the other experiments have as yet proceeded to a point where publication of results is considered advisable.

A judicial appraisal of the process at the present time is not easy. There are too many unsolved problems involved. However, an appraisal will be attempted by discussing: First, the unsolved problems, and second, the advantages of the method if these problems be solved.

The unsolved problems include: (1) The winter-weather problem. (2) The plant-supervision problem. (3) The sludge problem. (4) The cost problem.

The winter-weather problem may resolve itself in one of two ways: It may prove that the process will be economically possible in any part of this country, or that it will be applicable only for cities where the sewage throughout the year remains above a certain critical temperature. In this connection it should be stated that the temperature of the sewage itself will likely be a greater controlling factor than the temperature of the air introduced, as the air can probably be heated sufficiently at a low cost. The nearer the outfall sewer is to the center of population, the more likely will the sewage remain throughout the year above the critical temperature, and hence the more likely will the activated-sludge process be possible for that city.

The plant-supervision problem is an almost entirely unknown quantity for the new method. The lack of intelligent supervision of sewage-treatment plants in general has often been discussed in engineering periodicals and in text-books, and it is unfortunately an extremely pertinent subject for discussion. It seems probable, from the nature of the activated-sludge process, that it will require more intelligent supervision than most processes that have hitherto been in use. This is so, primarily, because of the comparative ease with which the sludge tends to lose its "activated" properties. The neglect of any one of a number of factors, such as air supply, sludge percentage, or detention period, will cause this loss of "activation." Should the process come into general use, it seems probable that in any plant where a sufficiently high standard of supervision does not obtain poor operation will at times occur and the effluent be below the required standard. In general, therefore, it is probably true that the successful application of this new process will enforce a higher standard of supervision. The necessity for such higher standard should be viewed by communities as a distinct advantage rather than as an evil, as it will help to keep that part of the public works above the influence of the political element.

The sludge problem cannot as yet be said to be definitely solved. It has been demonstrated that activated sludge has a higher fertilizing value than ordinary sewage sludge, and this fact has caused such firms as Armour & Company and Sulzberger & Sons Company to begin an active investigation of the process. The cost of realizing this fertilizer value, however, depends largely upon the cost of removing the moisture, and this is the feature regarding which no final figures are yet available.

The cost problem is obviously related to each of the three foregoing problems, but it is related much more intimately to the air problem. The greater portion of the cost of the activated-sludge process, exclusive of sludge handling, lies in the cost of air compression. Probably at least $3 of the $5 cost figure given by Mr. Hatton refers to air cost. If this cost estimate is based on power at ¾ cents or less per kilowatt-hour it is obvious that for a great many communities which are not able to secure power at less than 1½ cents the cost of sewage treatment by the activated-sludge method will be $8 or more per million gallons, *exclusive of sludge-handling costs*. It is highly desirable, therefore, that the cost of the process be reduced still further, and the most fruitful point of attack would seem off-hand to be the air cost.

If it be assumed now, for purposes of discussion, that all of the above problems will be solved—that winter weather will not prohibitively retard the biologic forces involved, that adequate supervision will be provided, that the sludge problem will be successfully solved, that the total cost of treatment is brought within the means of the average community—it is pertinent to consider the advantages of the new method compared with others.

The following will probably be its most important advantages: (1) Ability to control the quality of the effluent. (2) Lack of odor development. (3) Small plant area. (4) Low first cost.

If we assume that the plant has adequately intelligent supervision and that it is designed with a sufficiently flexible air supply, it will be comparatively easy to regulate the quality of the effluent to current requirements. This is not so true of a plant composed of Imhoff tanks and sprinkling filters. In the latter case the sprinkling filters must be designed sufficiently large to be capable of delivering the highest quality of effluent that will be required at any time. The cost of flexibility in such a plant is therefore first cost, which is a constant expense. In the activated-sludge method the cost of flexibility is principally operation cost, since the quality of the effluent may be largely controlled by varying the rate of air introduction. This advantage of the new method is more important than may appear at first sight. There are many communities for which the sewage-treatment problem involves simply nuisance prevention. For such communities it will be unnecessary to deliver as pure an effluent in cold weather as in warm weather, and for them the ability to regulate the quality of the effluent by means of a variable operating expense (which is never more than is actually required), rather than by means of a constant first-cost expense (which is for part of the year excessive), will be an unmistakable advantage.

The new method does not appear to develop objectionable odors in any part of the process, if we make a slight reservation in the matter of sludge treatment, regarding whose odor characteristics we are not as yet finally informed.

It is definitely established that the new method will require much less plant area than present methods delivering a corresponding quality of effluent. This will reduce the cost of land per unit of sewage flow to a much lower plane of importance and will make it possible to select sites nearer the center of population, thus reducing the length of outfall and increasing the freshness of the sewage.

The relatively low first cost of the method is primarily due to the fact that its "cubic performance" (for definition of term see Engineering Record, Dec. 18, 1915, page 751) is much higher than, for example, that of sedimentation and sprinkling filtration. The daily cubic performance of the activated-sludge method will probably be about two or three volumes of sewage per volume of device, whereas the sprinkling filter method has a daily cubic performance of only about 0.5 to 0.7 volumes of sewage per volume of device. Other factors such as the lessened land area and the lessened length of outfall sewer also help to reduce the first cost. Low first cost is important, because, for a great many communities the economic limit is not determined by annual cost but rather by bond issue, and for such cities it will be financially easier to install a "low first cost—high operating cost" system than a "high first cost—low operating cost" system.

Evidently then the process deserves the most painstaking investigation. Its possibilities appear to be very large. If the present difficulties can be overcome, we shall have added to engineering knowledge a valuable, if not the most valuable, method of disposing of liquid wastes.

Leading Situations in the Waterworks Field

DURING the year which has just passed, events of some significance have transpired in two cities of large population, in which the supply of water is not under municipal ownership—Denver and San Francisco. In both, there has been either decided or under trial litigations that are the aftermath of efforts to settle by agreement controversies of long standing, and, occasionally in their history, of intense bitterness of feeling. Litigation has followed upon the rejection by the citizens, in one case, of a plan proposed by a business organization, in the other, requiring a two-thirds vote, of an agreement between the city administration and the water company. In neither instance is it likely that this last word will drive the citizens to the construction of new plants, to the wasteful duplication of serviceable property, a possibility only, with the continued existence of exaggerated passion, of the passing away of which there are strong evidences.

In Denver, following upon the rejection by the citizens of a plan for the appraisal of the company's property for purchase, the City Commission passed an ordinance for a schedule of rates which had been drafted by the Public Utilities Commission and had been regularly initiated under the terms of the charter. The company sought injunctive relief in the U. S. District Court.

The special master, appointed to hear the issues, made a valuation of $13,415,899, found that the rates under the ordinance would yield a return of 3.64 per cent upon that valuation, and found that such rate was "not a fair or just return for the use of the property of the water company by the public." The report has not been approved by the court, pending arguments on exceptions to be heard in January.

From the valuation, "for rate-making purposes," the master excluded the item of pavement over mains, on the authority of the U. S. Supreme Court in the case of Des Moines Gas Company vs. City of Des Moines, and included the sum of $800,000 for "going concern value" on the same authority, setting forth that the valuation of the physical property had been estimated "as if the plant were about to commence serving the public, with its business yet to be established." As the property was "an assembled and established plant doing business and earning money," that "property right" had to be added to the valuation.

No additional sum was allowed for service connections, for preliminary expenses and organization, nor for working capital.

For water rights, the master found a value of $2,947,617, determining that these water rights were in the ownership of the company and not in the consumers, as had so clamorously been contended in this particular instance.

Should the court adopt the master's report, it is not improbable that it may form the basis of a final solution of the prolonged controversy. It finds the property to be in excellent condition, and states that "a new plant capable of serving the public with like efficiency cannot, according to the evidence, be built for $13,415,899."

The Public Utilities Commission has made no progress with the construction of a new plant, to be owned by the city, which they were directed, in 1910, to build at a cost not to exceed $8,000,000. Recently, a contract was let by the commission for the surveys for such new plant, and, soon thereafter, the commission contracted to purchase a reservoir and irrigation canal for $1,050,000, which contract was immediately met with injunction proceedings and a number of lawsuits attacking the ability of the assignor to convey.

The valuation found by the master has special interest to the engineering profession, because of its indorsement of that found by the board of engineers appointed in 1907 to make an appraisal of the same property. The board consisted of Messrs. Hazen, Freeman, Harrison, Holman and Stearns, and submitted a majority-report valuation of $14,400,000, for purchase. The substantial agreement, considering progressive depreciation, betterments and exclusion of certain items for rate-making, is a vindication of the much-assailed finding of the engineers, and especially so, in the matter of water rights, valued by the engineers at $2,845,925, and by the master at $2,947,617.

In San Francisco, the standing master in chancery is now hearing testimony on the ordinance rates, established by the Board of Supervisors since 1907. These rates have been imposed, annually, under the charter, injunction has been regularly secured by the Spring Valley Water Company, and over $2,000,000 is now impounded in court, pending this court decision. The submission of evidence has continued since early in July and will probably continue for some months.

Failing to secure the approval of two-thirds of the vote at an election held in April last, on the agreement to purchase the property for $34,500,000, made between the city administration and the company, it is probable that proceedings in condemnation, in all likelihood to be heard by the State Railroad Commission, will follow upon the report of the master in the rate cases.

Meantime, beyond building a small diversion dam and awarding a contract for the construction of a railroad leading to the dam site in the Hetch Hetchy Valley, the city has made no serious movement toward the construction of the new waterworks from the Tuolumne River, under the powers granted to it by the Raker Bill. Recently, the mayor vetoed the resolution of the Board of Supervisors to dispose immediately of $45,000,000 bonds for the Hetch Hetchy project.

In both cases, the progress toward actual municipal ownership is still tortoise slow. In neither case are the conditions favorable to rapid consummation of such policies; in both, and in Denver particularly so, there is evidence of a saner realization of the responsibilities such policies involve, and a growing disposition to a more just and reasonable attitude toward the water companies.

Irrigation in 1915

IN THE IRRIGATION FIELD the year just passed has brought little or no development of moment. With projects generally only partially taken up and practically none on a paying basis, neither the government nor the private interests could be expected to engage in new work. That which has been done has been in the way of completing projects already well along.

Conditions, moreover, are only a trifle more hopeful than they were a year ago. Settlers, generally, have not yet worked out their salvation, and the financial responsibility of the government, in the case of public projects, and of promoting companies, in the case of private ventures, is not yet at an end. The condition of the settlers, however, is improving and on some projects the real farmers are able to see the light, though the professional agitators are unwilling to admit it and are as loud as ever in protesting the hopelessness of irrigation farming.

The effort to repudiate the obligations to the government seems not to have lessened during the year, though it must be distinctly borne in mind that in times past as well as now the clamor comes from the speculative element rather than from the real farmers. This does not mean that the latter have not had very great, and in some cases insurmountable, difficulties. It does mean, however, that on the whole those who were fitted for the work and have toiled faithfully are in as good a condition as one might expect, and are not peddling their troubles in the press and on the street. Irrigation farming is development work, similar to the establishment of a business or of a manufacturing enterprise. One must expect a period of hard work, many disappointments and discouragements, and a goodly percentage of failures. To expect otherwise is to invest irrigation farming with a magic charm, differentiating it from all other development work.

The twenty-year extension law, passed in 1914, should now presumably be operative, but every effort is being made, on some projects at least, to postpone the date when it is made effective and the first payment will be due. In cases there may be warrant for such postponement, but those loudest in advocating it are the speculators who have unloaded their holdings on present owners and who know that repayments to them will be delayed if the government steps in and demands its first installment.

One would be more likely to take an attitude favorable to postponement were it not quite clear that strenuous efforts are being made to repudiate as large a part of the debt to the government as possible. The proceedings before some of the boards of reviews, which have been in session during the year, aiming to decide as to the fairness of charges against the projects, have been disgraceful orgies. With a lack of conscience that is positively astounding, efforts have been made to have the settlers relieved of almost every possible item of cost regarding which a clever lawyer could raise a question. Moreover, it is plainly said on the projects that if the fight is kept up long enough the government will eventually give the works to the settlers and expect nothing in return. With this feeling existing, one's temper is naturally not over generous. Unfortunately the bona fide hard-working farmer must suffer for the sins of the agitators, through whose wailings the attitude, or supposed attitude, principally becomes known.

One bright ray appears on the horizon—a disposition to make a fair and full investigation of conditions as they actually exist, with a view to supplying the needed remedy. Such views are those expressed by Dr. Elwood Mead before various conferences during the year and in the article by Edward Gillette in the issue of the Engineering Record of Dec. 25, page 789. This view—as to the necessity for a full and impartial study of conditions in an arid West—is finding many advocates at present and deserves to be supported.

When, however, the discussions favorable to such an investigation result in advocacy of a rural-credit system to be applied to the irrigation districts, without qualification as to the conditions of its application, one must dissent. Rural-credit systems when they come, under either state or federal auspices, should be generally applied and not merely restricted to irrigation projects. Moreover, so far as the U. S. Reclamation Service projects are concerned, no greater mistake could be made than to place a rural-credit system under the direction of the service. If in addition to the expenditures by the government in the engineering work, money were advanced to settlers for stock and improvements there would be all the more reason for the agitators continuing their campaign, for the stakes would be larger. If, on the other hand, the money were loaned by a banking department of the government, the settlers would appreciate that they would have to meet their obligations both as to interest and principal.

While, therefore, the Engineering Record is heartily in favor of a rural-credit system, it feels that it must be of broad application and must be administered under banking conditions.

While much activity in the way of construction cannot be expected during the new year, funds will probably be available for strengthening old enterprises and curing cripples. In fact, there is good reason for believing that considerable sums will be spent in the West in 1916 in this way. A year hence still further progress should have been made toward making existing projects pay, though it is useless to hope for really satisfactory conditions by the end of another twelvemonth.

Record-Breaking Bridge Work in 1915

WHILE there has been no distinctive technical development in the structural-steel field during the past year, several record-breaking structures have been under way or brought to completion. Two long steel-arch bridges have been closed, one the longest arch in the world, and the other the third longest. The desired progress in the construction of the Quebec bridge, containing the world's longest span, 1800 ft., has been made, the schedule for the working season of 1915 being completed as planned by Nov. 9.

About 32,000 tons of steel were placed in the Quebec bridge this season in somewhat over six months. The work included the erection of the falsework on the south shore, the south 515-ft. cantilever arm and main posts, part of the north anchor arm and the 580-ft. north cantilever arm. This means that about 44,000 tons of the total 63,000 tons of steel in the bridge have been erected. The double pins at the joints, driven in two or three minutes each, the extreme accuracy of the shop work, the yard-assembly reaming and the excellent field appliances, including flying falsework and electrically operated travelers, all contributed to rapid work. While the record day's tonnage in 1914 was 410 for one traveler, in 1915 the figure was 670.

The tonnage erected in the construction of the record-breaking 977½-ft. Hell Gate arch is naturally relatively small when compared with the Quebec structure. The work progressed with no special attempt at speed, and arch closure was successfully accomplished on Oct. 1, or four months after work on the main arches began. In that time 13,000 tons were placed. There is every prospect that by the end of the year all of the steel in the floor will be in position; in that event 19,000 tons will have been erected in seven months. During the erection of the plate girder approach spans for this bridge, a world's record of 1504 tons of steel placed in one day was made on March 8.

Another steel arch, the third longest in the country, but of much lighter construction than the Hell Gate, was successfully closed in Cleveland. The 591-ft. arch span with double-deck floor was erected in a little over three months—from July 29 to Nov. 5. Closure was made Oct. 8, by the use of screw toggles and telephone control, in about 1 hr. 50 min., while the corresponding closure operations for the Hell Gate arch, in which hydraulic jacks were used for the adjustment, required about 1¼ hr.

In both the Quebec and the Hell Gate bridges, special safety appliances were used in the erection, with the gratifying record of practically no accidents on work of monumental and unprecedented character. This was accomplished through the use of well-protected riveting stages and solid pin-driving or working platforms, and marks a new era in bridge erection.

Of the other record-breaking spans under construction, the erection of the superstructure of the Sciotoville riveted continuous truss bridge of two 750-ft. spans has not yet been started, while the longest simple truss span, 720 ft., in the Metropolis Bridge, will not be erected until next spring. The Tunkhannock viaduct, the world's largest reinforced-concrete bridge, 240 ft. high, was completed and put in service Nov. 7.

In spite of the two months' delay in starting, due to high water, the superstructure of the Harahan cantilever bridge over the Mississippi River at Memphis has been rapidly placed. The fixed span has just been swung and the anchor arm, one cantilever arm and one-half of the suspended span on the Memphis end have been erected.

The progress on these large structures and the successful completion of the steel erection on the longest arch span in the world mark the year 1915 as notable in structural history.

Valuation—Its Present Status

A FEW YEARS AGO the valuation problem was in the main treated by engineers as a subject for dispassionate scientific investigation, and the attempt was being made to formulate a set of fundamental principles applicable to all utilities. Now the scientific investigation has been disrupted by a grim battle for the inclusion or rejection in the inventory of items involving millions of dollars. The federal valuation of the carriers, which even two years ago was scarcely taken seriously, has become a great fact. It occupies most of the picture and its problems are clamoring loudest for attention. At the same time the non-engineering theorists have been indulging in a riot of generalities, resisted little by the engineering profession. Engineers as a body, following the failure of the special committee of the American Society of Civil Engineers to produce an acceptable code, have virtually stood still while the procession has moved by under other direction, until now their right is being challenged in some quarters even to discuss the larger problems.

One thing much needed is a rational classification of utilities and the principles applying thereto in order to offset the sweeping generalizations of theorists who see no difference between a railroad and a gas plant, and know nothing of practical operating difficulties. Specific matters that are pressing for consideration are depreciation and the depreciation reserve, the intangibles, and the reproduction cost of railroad land. The question of unearned increment is highly important, but as that is founded upon the very status of the utility with respect to the public, pure theorists, economists and the lawyers will probably exercise the greatest influence in determining the answer.

The land question is being handled by the railroads strictly from the legal point of view. This is unfortunate. The lawyers bow to a decision which many engineers believe was the inevitable result of faulty presentation of a particular case. Because in the Minnesota rate case Justice Hughes rejected pyramided multipliers, the railroads admit that all multipliers are illegitimate—saying which they disguise them under other forms, because there is no other way by which to arrive at reasonable reproduction land values. It would be better to carry the multiplier issue to the Supreme Court again, undisguised but properly supported, and in a case where the main issue is joined on this point, and then rely on the reasonableness—nay, inevitableness—of their use for victory.

Up to last spring the "other values and elements of value" called for by Congress floated around like a will-o'-the-wisp. They were frequently mentioned, but seemingly nobody had ever seen them. At the conference last May they were suddenly produced—five of them—by the railroads. One proved to be an old friend, "going value." Some said the other four—value of unity of use and connected operation, location value with respect to traffic, location value with respect to operation, and franchise value—looked so much alike that their own parents could not tell them apart. The railroads could not always distinguish them, and admitted that they had no scales to weigh them.

This journal would like to see going value put in its proper place as a tangible item, as real as crossties when defined as development cost, and readily estimated. The other four elements could probably be retired, with advantage to the railroad cause. Considering two competitive railroads, the advantage of one, in respect of each of these other elements, can only equal the disadvantage of the other, and the algebraic sum of all of these elements throughout the country will be zero. The interdependence of railroad rates has been pointed out by Director Prouty of the Division of Valuation. Certainly no individual railroad of any considerable length, whatever its value, can base its rates solely on that value. The country's rate structure is like a thick heavy fabric—a carpet, if you will. No single thread or small section can be dealt with independently. The sum of the valuations over a large area must be used to determine whether the fabric over that area shall be bodily raised or lowered. Manifestly, then, intangibles that cancel out in the addition have no significance.

Granted the foregoing, there still remains the question whether the intangibles of real value enjoyed by the local monopoly, by virtue of its being protected against competition, are entitled to inclusion in fair value for rate purposes. This applies to waterworks, lighting plants, short railroads and numerous other utilities. There is need for a more thorough analysis of this problem.

The depreciation question is as far from settlement as ever. This journal firmly believes that the railroads are right in their contention that with proper maintenance depreciation should not be deducted for rate-making purposes, and has supported the railroad argument for considering the whole track as the unit, and not the ties, rails and spikes. Nevertheless, with the Division of Valuation feeling that the law compels it to record estimated condition per cent and accrued depreciation for individual units, the railroads are evidently standing in their own light in opposing this. There are many possible uses of the valuations, and different values attach to different uses. The railroads are arguing for one value only, but surely the railroad itself, in purchasing a branch line, would not be indifferent to condition per cent, or the existence or non-existence of renewal funds. The possible hardship for the railroads is not in the recording of accrued depreciation, but in its deduction in determining a basis for rates.

It seems to the Engineering Record that the time has arrived for more consideration of the depreciation reserve. All agree that earnings should cover necessary renewals. Opinions differ as to the extent to which this should be done by the forehanded accumulation of renewal funds throughout the lives of the perishable parts, and as to the significance of the status of such funds prior to the time they are needed. Perhaps one difficulty is that in all the discussion of reserves we are dealing with something that, as far as railway road accounts are concerned, has not existed, and for that reason we have failed to note the problems that would arise with the creation of reserves. It would be well for both sides to declare more fully just what they think ought in the future to be covered by advance funds, how these funds should be calculated, to what extent they should be segregated, and how they should be rated in future valuations.

It is probable that during the coming year the special committee of the American Society of Civil Engineers will present another report. This is bound to be interesting, owing to the change in the personnel of the committee after the preliminary report was issued. By presenting doctrines that are at once ethical and practical, doctrines that the society at large will accept, thereby enabling the engineering profession to go on record as having definite views on the subject, the committee can do much to clarify the present confused situation. Two years ago, before the material side had been brought into prominence by the government's gigantic undertaking, it is likely that the public would readily have followed the leadership of the engineers. The task of gaining such leadership is far greater now than then, but with concerted action it can be done. And judging from the failure of those leading in valuation discussions to sweep away pernicious and unpractical theories on the one hand, and subserviency to legal precedent on the other, a new leadership is sorely needed. Charlatans seeking a cheap fame by railroad baiting there always will be, but by and large the public wants the truth, and will deal fairly if the views of agitators are properly exposed by those who see clearly, who know their subject thoroughly and are disposed to be fair. Surely no other group is so well qualified for exposing the fallacies and commanding confidence as the country's engineers.

The Hydroelectric Field

BUSINESS stagnation and lack of proper legislation are responsible for a practical cessation of activity in the hydroelectric field. Projects under way at the beginning of the year were completed, but little new work was undertaken.

Chief interest now centers in pushing through Congress legislation which will invite the investment of capital for projects on navigable streams and on the public domain. The Adamson and the Ferris bills, upon which so much work was put in the last Congress, died with the close of the session on March 4. The present Congress, however, will probably enact these measures, if not in the form in which they finally came from the Senate committees early this year, at least in some modification, and likely more favorable to investors than the committee measures were when they died last March. These measures are ever so much better than the existing rules under which the government grants permission for hydroelectric development. They are not, however, conducive to the greatest activity in development in their present shape and modification seems desirable. The large measure of discretionary power vested in executive officers of the government tends to deter capital, while the rejection of payment for appreciation, if the government should take over the plant, is economically unsound, denying to the investors the increase they normally expect and receive in connection with ventures not dependent upon government franchise.

The wastage of power is now nothing short of criminal, particularly since, if legislative conditions were favorable, development would certainly proceed. It must be granted that in some locations market for additional power does not at present exist, but on the other hand there are localities where development could proceed with full expectation of a paying, if not a capacity, load at profitable figures. In this connection the government itself is bringing pressure to bear upon Congress, for it realizes that the time may come when nitrogen fixation will be a necessary military measure.

This has been impressed upon the government by the reports of the Secretaries of the Interior and of War. Moreover, Dr. L. H. Baekeland, member of the Naval Advisory Board and chairman of its committee on ordnance and explosives, has reported to the Secretary of the Navy, advising that a fixation plant be built, so that a staff may be trained in the necessary scientific methods and act as a nucleus for the extension of the process should military necessity so require.

With pressure coming thus from both sides—from the capitalists who stand ready to invest in water-power development and from the government departments—one may safely predict that hydroelectric legislation which will unlock the present wasting resources is nearer at hand than ever before. This is particularly so, because a great amount of work, in which engineers have participated, has already been done on the needed bills.

Technically there is but little to record in hydroelectric progress. Well authenticated reports indicate that new records for sizes of units will be set when activity is resumed. Manufacturers stand ready to make guarantees on a 40,000-hp. unit under a head of about 100 ft. This is a tremendous undertaking and speaks volumes for the ability and courage of turbine manufacturers in this country. Speaking generally, one cannot look in the next few years for such rapid progress as was experienced in the last decade, for hydraulic design, then in embryo, has advanced sufficiently far to bring about standardization. Refinements are to be expected but radical departures are less likely than in the immediate past.

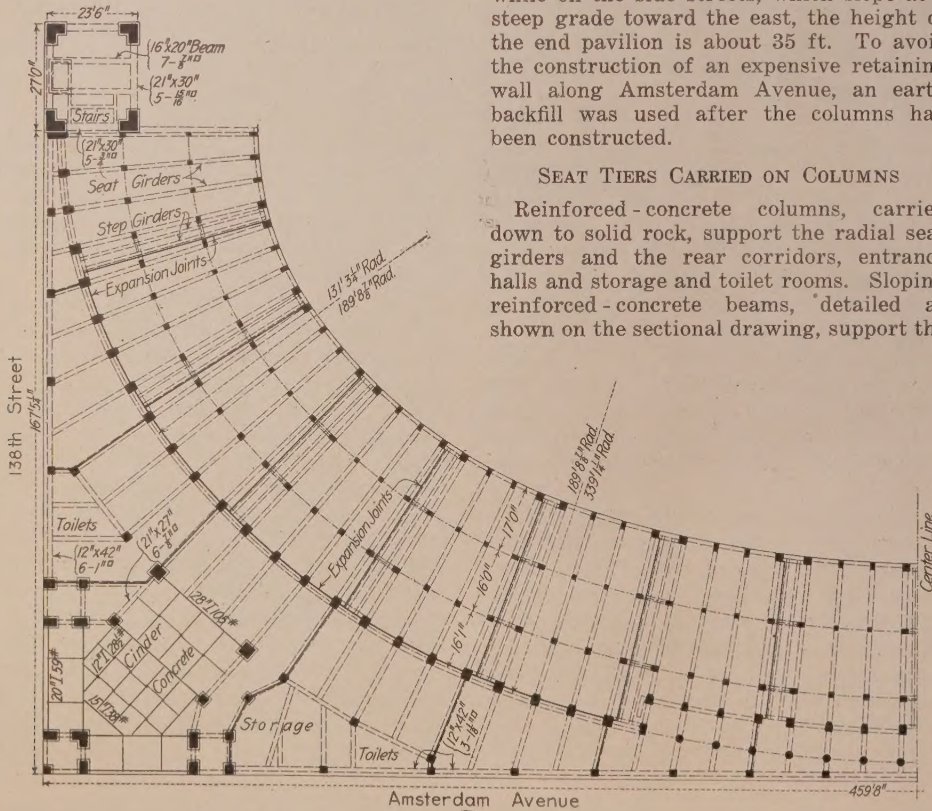
Architectural Possibilities of Reinforced Concrete Shown in City College Stadium

New York City Structure, Though Comparatively Small, Has Striking Appearance —Curved Seat Tiers and Corridor with Ornamental Columns and End Pavilions

UNUSUALLY striking in general appearance is the recently completed stadium of the College of the City of New York. Designed with structural economy to fit the given location, using reinforced concrete with float finish, the architectural treatment in classic style is worthy of its commanding situation on the brow of a relatively high hill. In appearance the structure is in a class by itself when compared with other college stadiums throughout the country, many recently completed and described in the Engineering Record during the latter part of the year 1914. Although relatively small, seating about 7000 as compared with the 61,000 capacity of the Yale Bowl, the New York stadium contains several unusual features in addition to the effective architectural plan. Expansion joints are introduced every 30 or 40 ft. The layout of the columns was facilitated by the use of rectangular co-ordinates. Special cantilever beams support the upper ends of the central stairs.

CONSTRUCTION BEGUN IN 1914

Construction was begun in the spring of 1914 and the main structure, including the step-supporting girders, was placed by December of that year. Some of the float finish was also completed. The excavation of the rock for the athletic field, which consists of a level rectangular space about 270 x 460 ft. containing a cinder running track 1/5 mile long, together with a baseball diamond and football field, did not begin until September, 1914.



HALF PLAN—EXPANSION JOINTS ARE LOCATED EVERY 30 OR 40 FEET

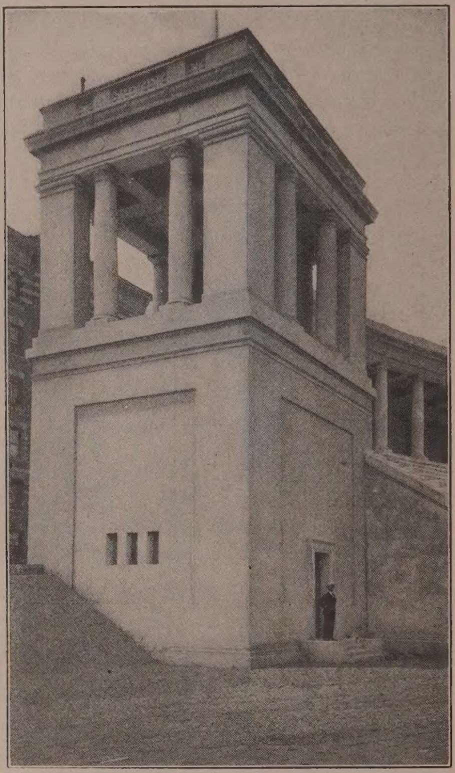
"The Stadium of the College of the City of New York" is inscribed in the upper panels of the Amsterdam Avenue side of the new structure, which is located on a lot extending about 460 ft. from 136th to 138th Streets; and about 350 ft. from Amsterdam Avenue to Convent Avenue. As Amsterdam Avenue runs along the brow of a hill at this point, and Convent Avenue is about 30 ft. lower, the structure was designed with sloping seat tiers on the Amsterdam Avenue side, curving in plan as shown and sloping toward the east to the field level, which is about the same level as Convent Avenue.

The circular rows of reinforced-concrete seats are constructed in sixteen panels between radial stairs leading to the main covered corridor. This corridor is inclosed on the outside by tile walls with cement finish, the reinforced-concrete columns giving rectangular panels as shown in one of the accompanying photographs. A modern renaissance architectural effect was produced by the row of cylindrical columns lining the inner edge of the corridor, and the treatment of the end pavilion and corner entrance halls. The main entrances are at each Amsterdam Avenue corner, and the structure is practically symmetrical about its center line.

At each end of the main corridors a two-story pavilion about 24 x 27 ft. in plan, containing on the lower floor the dressing rooms, shower baths, etc., for contestants, combines utility with architectural effect. The height of the roof above the sidewalk level on Amsterdam Avenue is about 24 ft., while on the side streets, which slope at a steep grade toward the east, the height of the end pavilion is about 35 ft. To avoid the construction of an expensive retaining wall along Amsterdam Avenue, an earth backfill was used after the columns had been constructed.

SEAT TIERS CARRIED ON COLUMNS

Reinforced-concrete columns, carried down to solid rock, support the radial seat girders and the rear corridors, entrance halls and storage and toilet rooms. Sloping reinforced-concrete beams, detailed as shown on the sectional drawing, support the concrete seat tiers. The latter span about 9 ft., varying according to height and position, and are designed as simple slabs and beams to carry a total live load of 90 lb. per square foot, the nearly vertical riser portion acting as the beam, being reinforced by one rod top and bottom, as noted. Stone concrete of 1:2:4 proportions, designed according to the New York building code, was used.


ARCHITECTURAL DETAILS OF PAVILION

The seat tiers are about 49 ft. in total width, each step having 28-in. tread and 16-in. rise. No permanent seats are provided. The slope was fixed by the total rise and the necessity for clear lines of sight from each spectator to any part of the field. The interior four panels contain special boxes with concrete walls, as shown in the photographs and plans.

The floors of the entrance halls are of steel beam and cinder-concrete slab construction, while the corridor floors are of 6-in. reinforced concrete between reinforced-concrete beams. The lower concrete columns are square or rectangular, reinforced with longitudinal steel rods resting upon steel plates as noted, while the upper cylindrical columns are reinforced with four rods and wire mesh and tied into the lower by the four ½-in. rods shown in the section.

LOCATING COLUMNS BY CO-ORDINATES—SPECIAL CANTILEVER BEAMS

The fact that the many columns supporting the curved seat banks are placed on compound curves of very long radii made their location rather difficult. A very sat-

GENERAL VIEW SHOWS ARCHITECTURAL POSSIBILITIES IN REINFORCED CONCRETE

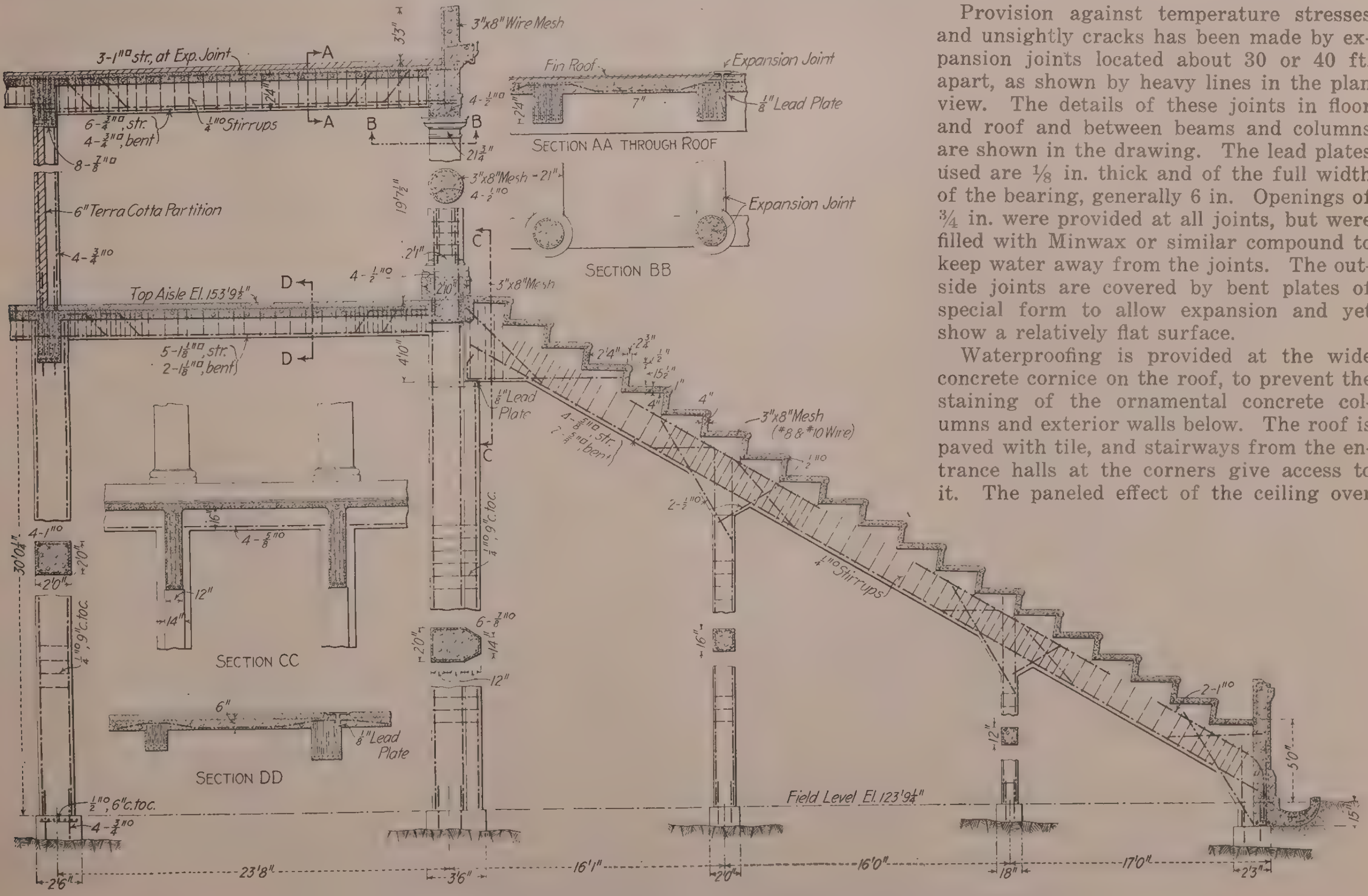
isfactory scheme was adopted. The x and y co-ordinates to a working point for each column were computed, using the building lines as axes and working from the intersection of Amsterdam Avenue and 138th Street as the origin of co-ordinates. Plans showing the relation of the sides of each column to its working point were drawn, and the forms were easily placed in accordance therewith.

The sloping radial beams supporting the aisle steps are carried on cross beams to the adjacent main radial beams. In the interior panels, where the boxes occur, it was necessary to cantilever the upper ends of these beams over the upper supporting girder, as shown in one of the drawings, where details of the inclosing walls of these boxes are also indicated. The steps are thus carried up to the level of the main corridor.

EXPANSION-JOINT DETAILS

Provision against temperature stresses and unsightly cracks has been made by expansion joints located about 30 or 40 ft. apart, as shown by heavy lines in the plan view. The details of these joints in floor and roof and between beams and columns are shown in the drawing. The lead plates used are 1/8 in. thick and of the full width of the bearing, generally 6 in. Openings of 3/4 in. were provided at all joints, but were filled with Minwax or similar compound to keep water away from the joints. The outside joints are covered by bent plates of special form to allow expansion and yet show a relatively flat surface.

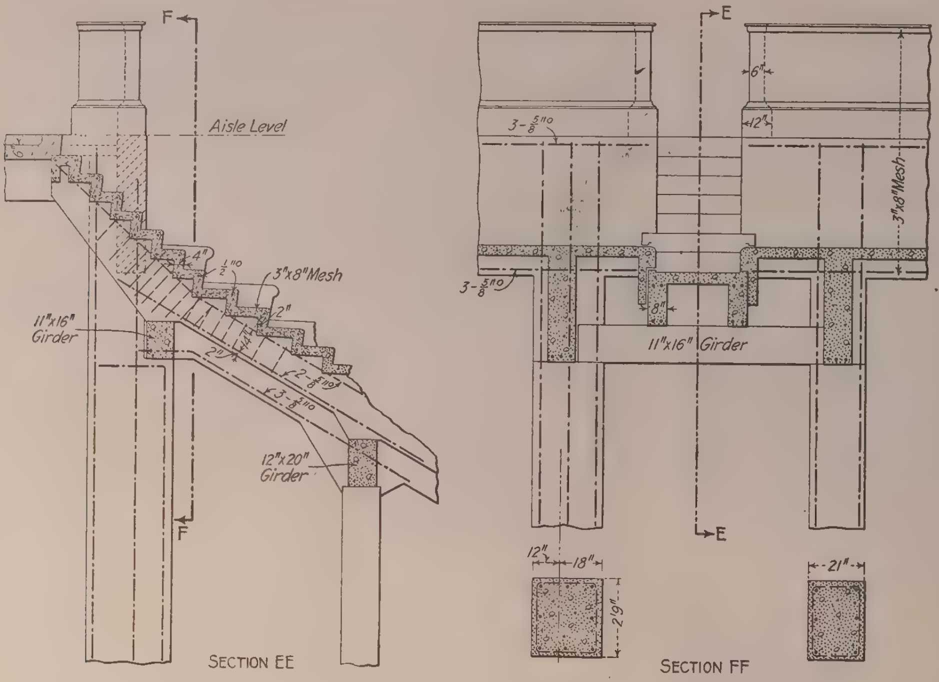
Waterproofing is provided at the wide concrete cornice on the roof, to prevent the staining of the ornamental concrete columns and exterior walls below. The roof is paved with tile, and stairways from the entrance halls at the corners give access to it. The paneled effect of the ceiling over



TYPICAL SECTION WITH DETAILS OF SEAT TIER CONSTRUCTION AND EXPANSION JOINTS the main corridors, resulting from the beam-and-slab construction, can be clearly seen in picture on the front cover.

The field was excavated 1½ ft. below final grade and then refilled with broken stone, cinders and loam, and provision for adequate drainage was made by a system of tile drains.

The architect of the stadium was Arnold W. Brunner, and Charles Mayer was the designing engineer. The general contractor was Jacob A. Zimmermann. The total cost was $250,000, the gift of Adolph Lewisohn. The site was furnished by the city.



DETAILS OF CANTILEVER GIRDERS AT TOP OF CENTER STAIRWAYS

Miter Gates for Balboa Drydock Nearing Completion

THE MITER GATES for the 1000-ft. drydock at Balboa are approaching completion, states the *Canal Record.* Both leaves have been swung. Except for their greenheart miter and quoin posts, the leaves are exactly like those of the lock gates, will be maintained from the same stock of spare parts, and are swung and operated in the same manner. In the case of the drydock gate, however, the leaves will be supported on carriages, running on the floor, when swung in the dry, to avoid severe strains on the pintle and anchorage. The carriages for the drydock leaves run on curved steel rails, embedded in the masonry of the floor.

Work is now in progress for the adjustment of greenheart miter and quoin posts on the south leaf. During the adjustment of these it will be necessary to swing the leaf in the dry, and it was for these operations principally that the carriages were devised. In the construction of the lock-gate leaves the miter and quoin posts were made of steel castings, to which bearing surfaces were attached and planed in place.

The greenheart timber posts were adopted for the drydock gate principally on account of the greater degree of watertightness anticipated, which is of more importance in a drydock which stands dry for the greater part of the time.

Minnesota Commission Offers Novel Valuation Views

In Brief Answering That of Railroads Before Interstate Commerce Commission Reproduction Is Assumed to Be Instantaneous

IN A BRIEF recently filed with the Interstate Commerce Commission the Minnesota Railroad and Warehouse Commission takes exception to the interpretation of reproduction cost set forth by the carriers at the conference of Sept. 30 and Oct. 1, 1915, on the ground that it is exactly what was rejected by the Supreme Court in the Minnesota rate case. Among the items objected to are various overhead charges claimed by the railroads. Some of the Minnesota Commission's logic is contained in the following quoted paragraphs:

"We submit that all such items as organization, promotion and legal expenses are so vague and indefinite as to clearly come within the condemnation of the Supreme Court as being entirely conjectural and solely based upon the false assumptions of non-existence and necessity of reconstruction. They have no bearing upon any item of property now being valued."

INTEREST

"The commission is asked to add to the value of the property an item for interest, upon the theory that during the time to be occupied by construction the property will be idle and unremunerative. The fact is, there is to be no construction, that the property being valued is not idle nor unremunerative.

"The only rational reason for the reproduction method is for ascertaining what advantages, if any, exist in prices of labor and materials between the present and the time of original construction.

"It is entirely irrational to assume any given length of time to be occupied by reconstruction. Presumptively it is instantaneous, and interest during construction has no place in determining present cost.

"It may be stated that railroads habitually are compelled to pay interest upon borrowed money during construction. Whether or not such a charge is proper when ascertaining original or actual cost is one question, but cost of reproduction ignores the original cost. It is intended to ascertain the present value of a physical item of property and the history of the acquisition of that article of property by its present owner, and the misfortune, loss or expense which may have attached to his original acquisition are entirely immaterial when the inquiry is not as to original or actual cost."

CONTINGENCIES

"It is impossible to imagine any rational grounds for allowing the item 'Contingencies' if the assumption of non-existence and necessity for reconstruction are irrational. . . . Since it is a matter of mere assumption, conjecture and imagination, no limit can be placed upon the item, and it is impossible to make an estimate which may be designated as reasonable. Everyone realizes that in actual construction contingencies and enhanced cost are met with. In imaginary construction, however, such items are solely imaginary and conjectural."

ENGINEERING

"In so far as engineering may be considered a labor item it is possible that in an estimate of reproduction cost some allowance should be made for it."

LAND

The commission recommends "that land be taken at no more than its market value for general use as measured by the value of contiguous lands, without any additions for special values, known as 'railway values,' or any additions by the use of multiples or hypothetical outlays, arising from payment of severance damages, or cost of acquisition." The commission then quotes from the familiar Minnesota rate decision in support of the foregoing.

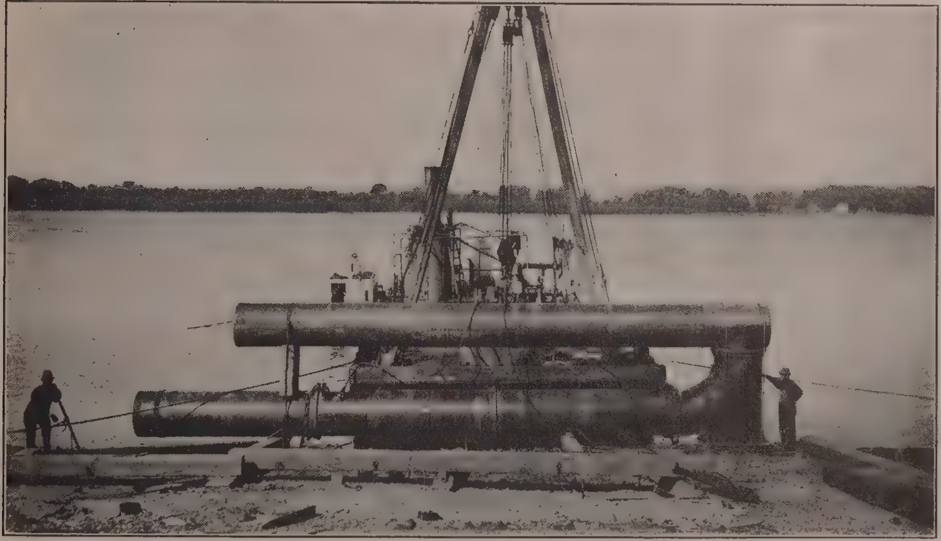
Two Large Government Sales

NATIONAL forest timber estimated at 188,100,000 ft. b.m. has been sold by the U. S. Department of Agriculture. The timber is on two tracts, one in the Plumas National Forest in California, the other in the Wasatch National Forest in Utah. Sugar pine is the most valuable timber in the former tract, and the bid price was $3.25 per thousand, it being estimated that there is nearly 26,000,000 ft. b.m. on the tract. The bid for yellow pine, the amount of which is put at more than 37,000,000 ft., was $2.60. Douglas fir, white fir and incense cedar, aggregating 43,000,000 ft., brought an average bid of about 70 cents. The purchaser is allowed an operating period of fifteen years, but the prices are subject to readjustment every five years. The Utah timber will be cut chiefly for railroad ties. It comprises, according to the government's estimate, 82,100,000 ft. of green and dead lodgepole pine, Engelmann spruce and Alpine fir. The sale price is 10 cents for each tie cut and ½ cent per linear foot for mine timbers. These two sales are, with one exception, by far the most important made this fiscal year. The year is expected to run considerably above last year in receipts for timber sales, the first five months having shown an increase of nearly 40 per cent.

New Quincy Intake Characterized by Provision Against Accumulation of Sand

Line Laid in Gravelly River Bed to Replace Old Wood-Stave Line—Constructed in Sections on Skids on Shore

IN CONSTRUCTING the new intake for the water supply of Quincy, Ill., the entrance of sand from the gravelly river bed was provided against by locating the 36-ft. screen with its longitudinal axis approximately parallel to the direction of the flow of the river, so that water drawn through it must flow against the current to pass into the intake pipe. To conform to the contour of the bed of the stream two abrupt changes in the grade were necessary. At the foot of the rising grade a tee was inserted in the line, with the side opening turned up and flanged. It was assumed that if any sand did get by the screen it would lodge at this point. The opening in the tee is sufficient to provide ample room for a diver to enter the pipe or for the suction pipe of a dredge pump to be inserted to remove the accumulation. The trench for the pipe line was excavated by dredges, and the line made up in sections on skids on shore, which were taken up by an A-frame derrick on a scow, towed out to the proper location and lowered into place.



INTAKE SCREEN SECTION MADE UP READY TO BE TRANSPORTED AND PLACED

The intake line is 1823 ft. long, with the shore end in a brick intake well 15 ft. in diameter and 30 ft. deep. This well was built in 1887 and is located about 20 ft. from the water's edge at ordinary stages of the river. The water flows by gravity into it and is drawn out by a low service pump under a suction lift of 15 ft. with the river at low-water mark. The submerged end of the pipe is made up of a 36-in. 90-deg. bend, with a bell end, into which is threaded and securely clamped a steel frame. The screen is 36 in. in diameter and 36 ft. long, with both ends closed. The downstream end and 31 ft. of the total length are perforated with ⅝-in. holes totaling in number 29,293. The total area of the perforations is equivalent to 8.8 times the area of the intake pipe.

This was landed in a trench in the river bed with the screen above the pipe. The highest point of the screen is 8 1/3 ft. below low-water mark in the river. The normal depth of water at the point is 14 ft. It is tied in place by white-oak piles and 1⅛-in. steel rods. As the bed of the river is sand and gravel the screen was located in the main channel in such a way that the direction of the flow is approximately parallel to the longitudinal axis of the screen, so the water drawn through must flow against the current to pass into the intake pipe.

The connection through the wall of the well was made by means of a special casting 6 ft. long, with a standard bell on the river end and a standard flange on the well end, to which was bolted a 36-in. flange gate valve and a second flange which came flush with the outside wall of the well to resist the thrust of the water when the valve is closed.

Due to the class of material encountered the excavation at the well was somewhat difficult. The trench was 24 ft. deep, through a filling of earth, cinders, brickbats and loose stone. The digging at this point was done by an orange-peel bucket suspended from a 60-ft. swinging boom. For other excavation a 10-in. centrifugal dredge pump mounted on a scow was used.

The excavation on shore was carried down to the water line to a width sufficient for the driving of sheet piling for a cofferdam 8 ft. wide. The planks were driven to bedrock, which was from 3 to 8 ft. below low-water mark. Two lengths of bell-and-spigot pipe and one-half of a Falcon flexible ball-joint pipe were placed and calked inside the cofferdam.

In the work of pipe laying skids were laid out and leveled up at a convenient point just above low-water mark on shore and arranged so as to support four lengths of pipe parallel to the shore line. The pipe was rolled upon the skids and made up with lead joints calked with pneumatic hammer, usually in sections of 48 ft.

All of the sections, except at two points where flexible ball-joints were used in order to make changes in the grade line, were made up with a special bell, 6 in. deep, at the forward end and a special machined spigot at the rear end. There was also a bead cast on the pipe 18 in. from this spigot end. The lead was poured into the bell at the forward end, around a cast-iron form which was turned to the exact shape of the machined spigots used on the rear end of the sections. After the joint was set this form was drawn out, leaving the lead in the bell, and heavy steel clamps were bolted around the pipe back of the forward bell and around the bead at the spigot end.

When a section of pipe was to be taken out for laying, a large scow was anchored with the A-frame derrick over the section to be hoisted at the middle point, and with the end of the scow against the side of the pipe. Two hitches were then made around the section, which was hoisted off the skids, and the scow was pushed out to an anchorage over the pipe line. A trench was prepared by the dredge pump and the scow was moved sufficiently to bring the A-frame with the suspended section to proper position over the line. The pipe was then lowered and the spigot end entered into the bell of the preceding section by a diver. Two heavy bolts were passed through the clamps which had been bolted around the bell and spigot, and the spigot was forced as deeply as possible into the cold lead in the bell by tightening the nuts on the bolts. The diver then calked around the pipe with a pneumatic hammer. All of the clamps and bolts were left in place. No backfilling was done over the pipe, as the sand drifted into the trench very rapidly.

TWO FLEXIBLE JOINTS

Two Falcon type flexible joints were used at points where the contour of the river bed required abrupt changes of grade. The first was placed within the cofferdam, 30 ft. outside the wall of the well, and the second 147 ft. from the first. In this distance the grade line dropped 12 ft., which placed the top of the pipe 11 ft. below low-water mark. The remainder of the line was carried at this elevation practically to the end. This required the dredging of a depth from 2 to 9 ft. of sand.

It was assumed that if any sand ever accumulated in the pipe it would lodge at the foot of the rising grade, 175 ft. from the well. A 30-in. tee was therefore inserted at the second flexible joint. The side opening of this tee, which was turned upward, was flanged and closed by means of a blind flange, which may be removed at any time by a diver, and the opening is large enough to permit the entrance of a man or the suction pipe of a dredge pump.

The intake was designed by W. R. Gelston, superintendent of the Citizens' Waterworks Company, who also had charge of the construction. Joseph G. Falcon, of Evanston, Ill., was the contractor. The line was laid to replace a 30-in. wood-stave pipe installed in 1887 and still in good, serviceable condition, but so located that the supply was sometimes contaminated by the city's sewage.

The cost of the line was as follows:

356.395 tons 36-in. B. & S. pipe at $22.65 per ton f.o.b. Quincy................	$8,072.34
1 36-in. flanged tee, 5470 lb. at 3¾ cents	205.13
1 piece 36-in. special pipe, 2920 lb. at 3¼ cents	94.90
1 90-deg. ell, 5060 lb. at 2¾ cents......	139.15
36 x 3-ft. steel screen furnished by the contractor as an extra...............	100.00
20,400 lb. pig lead at $4.025 per hundred-weight	821.10
600 lb. yarn at 5 cents................	30.00
1823 ft. of pipe laid at $7 per foot as per contract	12,761.00
	$22,223.62

The total cost averaged $12.19 per foot. For the price of $7 per foot paid the contractor he was obliged to unload all of the material at Quincy and to furnish the necessary piling, clamps, bolts and all other material not listed above.

Soft-Ground Tunneling Has Advanced Rapidly Since Early Days

THE FIRST tunnel driven in soft ground with the aid of a shield was that under the Thames River in London, begun in 1828 and finished in 1843. An outline of the progress of the art of tunneling in soft ground since that date was given to the Municipal Engineers of the City of New York on Dec. 22 by Howard B. Gates in a paper on the Harlem River crossing of the Lexington Avenue subway (See Engineering Record of Sept. 13, 1913, page 284; Oct. 4, 1913, page 390; Oct. 11, 1913, page 404, and May 15, 1915, page 616).

The shield used on the first Thames River tunnel was invented by Sir Isambard Brunel. In driving the second tunnel under the Thames in 1869 Peter William Barlow used iron lining in connections with a shield. From these inventions has grown the shield method as we know it at present. The first application of the shield to tunneling in America was made in 1869 when a short piece of tunnel was built under Broadway in New York City by the use of a shield designed by A. E. Beach. It is claimed that he was the first to make use of hydraulic pressure to force the shield forward. The original franchise for the project contemplated the construction of a tube 8 ft. in internal diameter, beginning at the post office at Warren Street and extending northerly under Broadway, to be operated by pneumatic methods, presumably for the transportation of mail, parcels and light freight. Altogether 250 ft. of this tunnel was constructed, 200 ft. of it being straight and lined with brick, and 50 ft. being constructed on a curve and built of light cast-iron segments. During the construction of section 2 of the Broadway-Lexington Avenue subway in 1912 this tunnel was unearthed and removed. The shield was found intact, except for wooden parts which had rotted away. An experimental car designed to fit the interior with very little clearance also was found in the main tunnel, bearing evidence of an attempted practical demonstration of the scheme.

First Use of Compressed Air

The first subaqueous tunnel attempted in New York City was begun in 1879 at the Jersey end of what is now known as the McAdoo or Hudson & Manhattan uptown tunnels. DeWitt C. Haskins proposed to tunnel the Hudson River silt by an application of building caisson methods. He planned to build the working chamber of light iron segments bolted together. By the use of compressed air, the escape of which he sought to prevent by placing a painted canvas on the river bed, he believed it possible to excavate safely for the top center segment, and, with this one in place and bolted, to gradually add others, completing the ring. The method was tried, but following accidents of lesser importance, an inrush of mud and water caused the loss of about twenty lives and necessitated a change of plans.

A pilot tube method was then devised for continuing the work. This consisted of building a smaller tunnel about 6 ft. in diameter along the axis of the larger one and lining it with plates similar to those previously used. The pilot tunnel was kept from 50 to 60 ft. in advance of the full-sized excavation, which followed and was lined with thin plates supported by radial struts bearing upon the pilot tube. A brick lining completed the structure. As the full section advanced the plates of the pilot tube were unbolted and reassembled at the advanced face. After many vicissitudes, Haskins was obliged to stop work in 1888, having completed about 2,700 of the 11,500 ft. contemplated. He had, however, demonstrated the possibilities of compressed-air support. This was the first use of compressed air in any important tunnel, and Haskins believed the idea to be original with himself. However, a compressed-air tunneling system had been patented in England by Admiral Cockrane fifty years before.

In 1889 the Hudson tunnel enterprise was taken up by English contractors and work was resumed by the shield method. This was the first application of the shield to subaqueous tunneling in this country. Owing to a shortage of funds, this work was interrupted again after a progress of 1700 ft. had been made. Nothing further was done until 1902, when the railroad company was reorganized under the management of William G. McAdoo and the tunnels were completed.

Broken Track Stringers in Bascule Bridge Lead to Proposed New Floor Design

Coping of I-Beams to Increase Clearance Is Probable Cause of Cracks in Webs—Proposed Stringer to Support Rail on Cast-Steel Separators

By F. H. Avery

Engineer in Charge of Bridge Construction and Design, City of Chicago

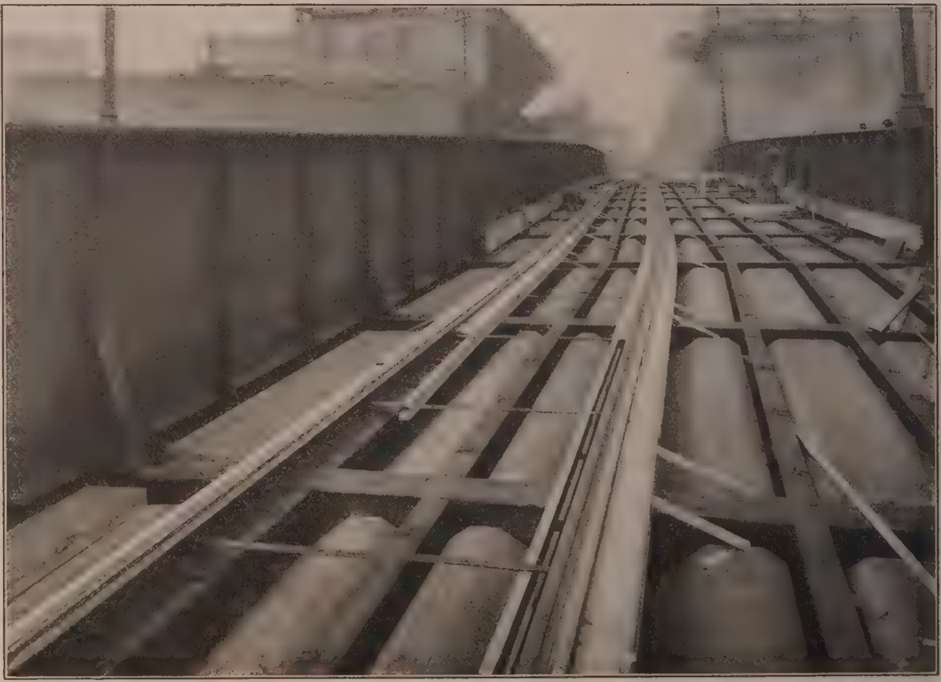
AFTER the timber decking of the State Street bascule bridge, Chicago, was removed, in order to replace it with a concrete slab, examination disclosed the fact that twenty-one out of twenty-four track stringers on one roadway of the viaduct were badly shear-cracked, the cracks starting at the cope in the top flange of the I-beam. About the same number with broken webs were found in the other roadway.

The viaduct is of through girder construction with shallow floor and I-beam stringers coped to fit the top flange angles and cover plate of the floorbeam, in order to decrease the floor depth. The track stringers were 12-in., 31½-lb. beams with a 12 x ⅜-in. plate on top to receive the old 6-in. tram rail. The decking consisted of 4 x 6-in. subplanking laid at 45 deg. on 12-in. centers, and 4-in. oak planking for a wearing surface. The nature of the cracks discovered in the stringer webs upon removal of this decking is clearly shown in the photograph on page 16.

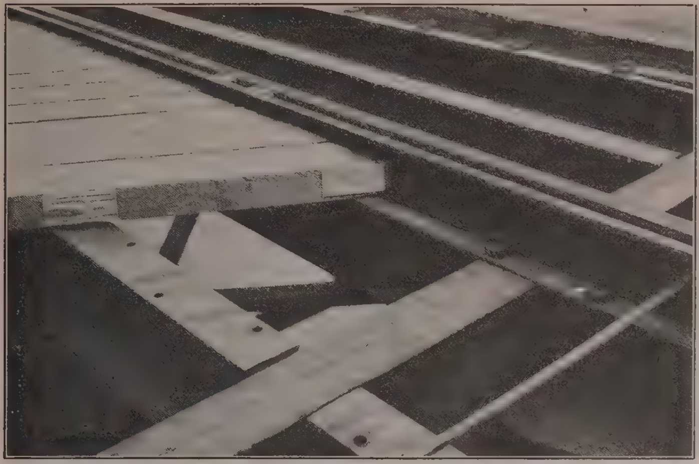
New stringers were ordered, using 40-lb. instead of 31½-lb. I-beams, and coped the same as before. It was not practicable to avoid the coping, and the increased weight of the I-beam in addition to the concrete floor is relied upon to prevent a repetition of this method of failure. New rail has been laid on the viaduct, and the joints have been made at the center of the stringer so that the deflection of the stringers will aid in taking up the pounding of the wheels at the rail joints.

Coping Should Be Forbidden

The coping of I-beams originated in building construction and established itself so thoroughly that not much thought was given when the same construction was used in bridge floors. This particular floor shows very plainly that for the stringers under street-car rails the practice should be absolutely forbidden. It should be forbidden for all the roadway stringers of bridges in cities having heavy team traffic, owing to the high speed and heavy axle load of auto trucks, which cause pounding as severe as



ARCHED CONCRETE FLOOR—STRIPS ALONG RAILS PERMIT PLACING OF BROW CONCRETE



SUBPLANKING CUT AT ENDS TO FIT OVER RAIL FASTENINGS

HEXAGONAL PAVING BLOCKS LAID WITHOUT CUSHION

the street-car wheels, especially after the pavement becomes worn.

Another fault in bridge floors noted in this bridge is that the rail plate, due to the movement of the rail, is worn down a good quarter of an inch, so as to cause the plate to crack along the edge of the I-beam. This rail plate and the top flange plate of the floorbeam are level, hence the same groove is plowed across the top of the floorbeam. This again is due to making the floor too shallow. The rail should be at least ½ in. above the floorbeam and should never bear on it.

A second photograph shows another bad feature of most floor designs. The rail fastenings as seen in this photograph project 2½ in. above the rail plate. The result is that there is but 1 in. of timber above the top of the rail fastening. This condition, since it occurs alongside of the rail, is particularly bad, as the wagon wheels drop off the rail and soon break these weak ends of the subplanking, and then the destruction spreads in the subplanks until they begin to loosen and see-saw up and down under traffic.

This design has been accepted practice and is still used to-day. It is time, however, to devise better construction for floors carrying the heavy cars and trucks of present-day traffic.

FORMS AND PAVING BLOCKS

One of the photographs shows the forms in place and the method of keeping an open space next to the rail to permit setting the brow paving, which is 1½ in. deeper than the wooden blocks. The slabs were reinforced with ½-in. square bars on 9-in. centers and bent down alternately to the bottom flange of the stringers to act as stirrups and hold the thin piece of concrete next to the I-beam web in case it cracked.

Hexagonal paving blocks were used for two reasons: First, to avoid most of the expansion troubles, since each block is the entire log of wood and hence is subjected to radial expansion only, which is about one-third as much as the tangential expansion of the rectangular block. Second, each block is 100 per cent heart wood and so can be face-nailed to the subplanking without the block cracking. This is necessary on a bascule bridge in order to hold the pavement when the span is raised.

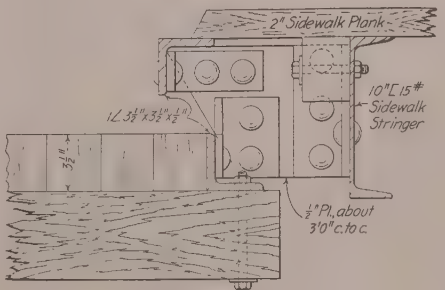
This nailing was tried experimentally on several well dried blocks, and it was found that not only could a 60d wire nail be driven to the head of the nail into the block, but that a follower could be placed on the nail and the head driven clear through without splitting the block. This is impossible with a rectangular block and was the deciding factor in the selection of the hexagonal type.

The cost of the blocks was $1.64 per square yard, delivered, treated with creosote, 10 lb. per cubic foot, Rueping process. The blocks are laid directly on the concrete, but not from choice. Had there been enough room vertically they would have been laid in ¾ in. of cement mortar mixed dry.

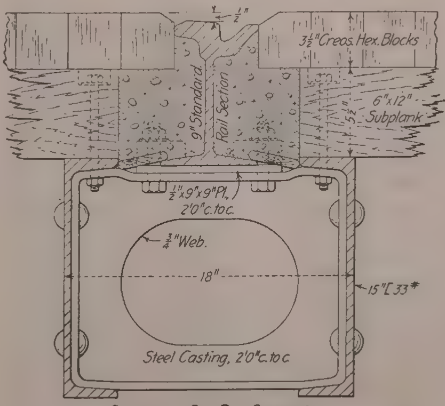
PROPOSED FORM OF TRACK STRINGER

The drawing shows a proposed form of street-car stringer made of two 15-in., 33-lb. channels, with cast-steel separators. The castings have a flange on all four sides and one central web, with a large hole to reduce weight, and four rivets fastening them to the channels. The rail rests on a 9 x ½-in. plate, with four bolts to the casting. The castings are 9 in. long in the direction of the rail, spaced 2 ft. on centers. Spacing greater than this would be dangerous in case a rail should break.

The subplanking rests on the channel flanges, and if cut flush with the inner edge of the channels gives 2½ in. clear opening between the planking and the rail, or enough room to remove and renew the track bolts through the casting without touching the subplank. This is the greatest advantage of the proposed floor; that is, the ability to renew the rail without removing the entire floor. The importance of this feature cannot be too strongly emphasized, for in many cases where minor repairs have been made to the rails, the street-railway gangs have deliberately cut away the subplank with an ax, beveling it at 45 deg. in order to get at the bolts. Such a plank would fail shortly afterward, and thus disclose what had caused the failure.



SECTION AT CURB



SECTION AT CAR RAIL STRINGER

PROPOSED STRINGER AND CURB DETAILS

To hold the concrete, shown in the sketch, between the castings, place a piece of ½-in. wood about 3 in. wide between the rail and the subplank, and place the concrete, which is shown on the drawing as concrete, but which is really cement mortar and can be readily dug out if necessary to give access to the rail bolts.

COMPARISON OF STRINGER WEIGHTS

On a Chicago-type bascule bridge the street-car stringer is a 15-in., 42-lb. beam and a 12 x ⅜-in. plate, making the total weight 57 lb. per foot. The proposed section weighs 66 lb. for the channels and 46 lb. per foot of beam for the castings and ½-in. rail plate, or a total of 112 lb., about double the old weight. The length of rail on one leaf is 90 ft. or 360 ft. for four rails, so that this means an increase in weight of 10 tons.

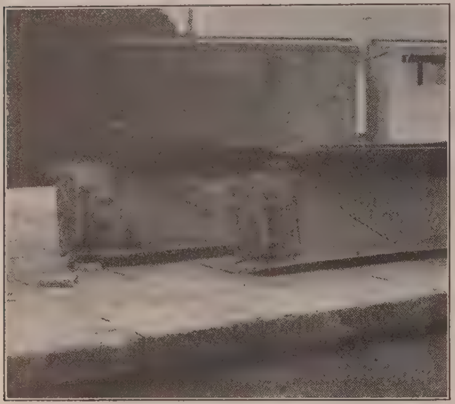
The center of gravity of the rails is 51 ft. ahead of the trunnion and for the counterweight 21 ft. back of the trunnion, so that this increase of 10 tons means 24 tons added to the counterweight. As the counterweight for one leaf weighs 550 tons this is not a great increase.

The saving in repairs on a bridge with the proposed type of floor would far offset the increased cost due to additional steel and counterweight, for not only could the track repairs be made without disturbing the subplanking, but the subplanking would last longer, since the ends would not be cut to pieces in order to allow notching over the track bolts.

CHANGED DETAIL AT CURB

The drawing shows the curb end of the subplank, and a change introduced in order to cheapen repairs. In the usual type of bridge floor removal of the subplank required tearing out the 10 x 12-in. oak guards, and this meant to tear out the chord cover and sidewalk plank. The new type of guard has a clear space between the guard angle and pavement so that the street dirt will blow under it and not come pouring down on the pedestrians every time a lift is made. It is possible to repair the subplank without disturbing the guard angle or sidewalk.

This floor change, simple as it seems, will result in a great saving. In the old form, the street dirt lodged against the guard timber and soon rotted it, while the removal of subplanks meant chopping out the guard timber, as a rule, and always required removing the guard angle and sidewalk or chord cover.



COPED STRINGERS SHEAR-CRACKED BY IMPACT OF CAR WHEELS

The repairs to the viaduct were made by the Department of Public Works of the city of Chicago, under the direction of John Ericson, city engineer, and Thomas G. Pihlfedt, engineer of bridges and harbors. The field work was in charge of H. J. McDargh, bridge designing engineer.

LIME FROM SLUDGE AT COLUMBUS, OHIO, has been made experimentally of 65 per cent CaO. About 2½ tons were prepared in a rotary kiln into the upper end of which the wet sludge is pumped. The lime comes out in rounded pebbles 1 in. in diameter and smaller. C. P. Hoover, chemist in charge of water purification, says it is the intention to build a rotary kiln 100 ft. long and 5 ft. in diameter to burn a large part of the lime needed from the sludge.

Work on Hetch Hetchy Water Project Begins

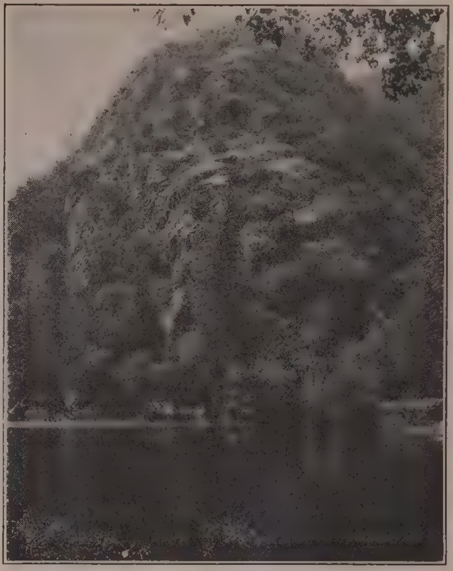
Preliminary Construction Well Under Way on San Francisco Water Supply—Plans Include Roadbuilding, Tunnels, Hydroelectric Plants and 67-Mile Railroad

FINANCIAL conditions limited the work done during the past year on San Francisco's Hetch Hetchy water supply project, but surveys, designs of structures and preliminary construction have been actively under way. The grading of the first section of the main road from Hog Ranch to the dam site, 9.09 miles in length, was completed this year. This section of the route, which is to be followed by the railroad to the dam site, involved the most difficult construction on the entire line. It lies in extremely rough country and the roadbed had to be excavated almost entirely in solid granite. A total of over 152,000 cu. yd. of material was handled in the 9-mile stretch at a total cost, including culverts, retaining walls, etc., of about $190,000.

SAWMILL REDUCES LUMBER COSTS

Owing to the cost of lumber in the open market it was considered wise to erect a sawmill for utilizing some of the timber on the area owned by the city. The sawmill installed at Canyon Ranch began operations on Aug. 1 and has already cut more than 1,000,000 ft., board measure, for use in camp construction, concrete forms, etc. In addition to all timber for forms it is expected that the railroad ties for use on the line to the dam will be cut by this mill. The mill is operated by a sawmill logging engine which will be used after mill work is finished on the construction of the dam proper.

The 800 acres to be submerged by the diverting dam are being cleared by a crew of 100 men, who have been rushing the work in order to clear the site before there is sufficient snow to interfere. This diversion dam will direct the waters of the Tuolumne River into a tunnel around the main dam site while the large impounding dam is being built next year. With the river diverted it will be possible to make borings to determine more accurately the character of foundation for the main dam.



SOUTH ABUTMENT OF HETCH HETCHY DAM

SAWMILL WAS ERECTED TO SUPPLY TIMBER FOR HETCH HETCHY CONSTRUCTION

After an extensive study of the type of dam to be built, a gravity section, arched to afford additional safety, was tentatively chosen. The detailed designs of this structure, the cost of which will be approximately $4,000,000, are now practically complete, but before final approval they are to be passed upon by an expert who has not yet been named by the city. The tentative designs call for a structure 750 ft. long on the crest and 300 ft. high. After the more detailed examination of the unwatered dam site by diamond drill test borings and an examination of the geology the present plans for the main dam may be altered somewhat.

Work is now under way on the Early intake, which is a tunnel 10½ to 13 ft. in diameter, 20 miles in length, traversing, for the most part, solid granite formation between a point 12 miles below the dam and a forebay above the Moccasin Creek power plant.

Work is also under way on the diversion tunnel, 20 ft. in diameter, which will bypass the flow of the Tuolumne River while the main dam is under construction. This tunnel must be completed before the diversion dam can be of service and is expected to be ready before the first of the year. Progress has been made in this tunnel at the rate of 36 ft. per week, working double shifts of 8 hr. each. Materials for the diversion dam have been delayed somewhat, and it is thought possible that it may not be completed until next spring. The borings at the diversion dam have developed bed rock at a depth of only 22 ft. below water surface.

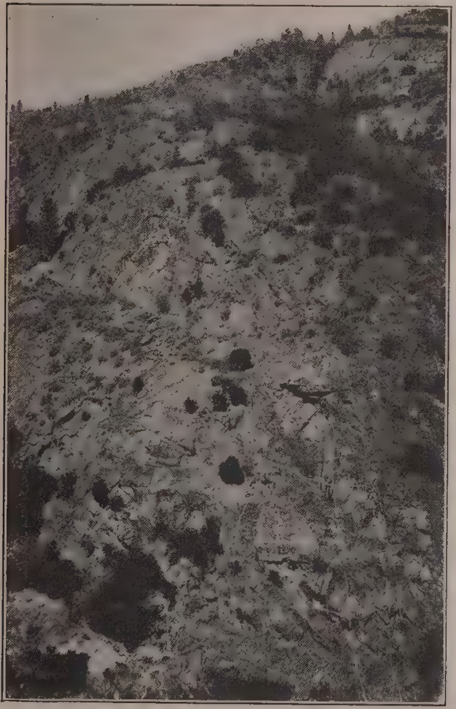
POWER DEVELOPMENT PLANNED

After studying the topography of the route to be followed by the aqueduct a board of consulting engineers recommended a definite plan for the development of power which has been, with some modifications, adopted by the city. In order that the capital invested should be a minimum the power is to be developed and sold progressively; the most important site, Moccasin Creek, where it is expected ultimately to develop a total of 72,000 kw., will be laid out for this capacity at the outset, but will be equipped unit by unit as the market for power develops.

In its ultimate equipment this plant will be able to handle the capacity flow of 620 sec.-ft. under a head of 1250 ft. Space will be provided for six 12,000-kw. generators operating on a load factor of 65 per cent, one generator to be a spare unit. This plant will be expected to carry a peak load of 76,300 kw. at the switchboard, the average power being 49,600 kw. Conduits are to be built at the outset for the full capacity of 400,000,000 gal. per day, which is said to be ample for the future needs of greater San Francisco.

HETCH HETCHY RAILROAD

The site of the Hetch Hetchy dam is on the headwaters of the Tuolumne River in a deep valley of the Sierras about 4000 ft. above sea level and nearly 70 miles from the nearest railway line. It has been determined that the amount of material to be hauled to the dam during construction is so much that it would pay to build a railroad, even though its entire cost had to be added to the cost of the dam. Plans and specifications have accordingly been made by the city engineer for a railway 67 miles in length extending from the junction with the Sierra Railway at Rosasco to the dam. Six bids on this work, ranging from $1,543,080 to $2,000,000, were recently received. This line follows the general course of the Tuolumne River through extremely rough and broken country. Most of the line going toward the dam is on a 3.4-per cent grade. Since the line is for freight traffic only, sharp curvature has been permitted in location; the sharpest curve is 30 deg. and curves of 18 to 26 deg. are common; guard rails are to be laid on all curves sharper than 12 deg.



NORTH ABUTMENT OF HETCH HETCHY DAM, SHOWING PROFILE PROPOSED

The construction of this line involves excavation totaling about 1,000,000 cu. yd., of which more than one-half is rock. The line will require about 6,700 lin. ft. of culverts; 40 miles of fencing and about 500,000 ft., board measure, of timber in trestles. The roadbed will be 16 ft. wide at subgrade with embankment slopes specified as 1½:1. Redwood or cedar ties 8 ft. long and 60-lb. rails are to be used. The specifications call for 6 in. of ballast underneath the ties.

The only bridge of long span is that required in crossing the Tuolumne River near Jacksonville, which will have a maximum span of 220 ft. and with three-plate girder spans on the apparatus will require 600,000 lb. of steel. Terms of the contract require the entire line ready for operation within 300 days from date of award, with the specified penalty of $750 per day for each day's delay in final completion.

The entire work is being carried out under the supervision of M. M. O'Shaughnessy, city engineer of San Francisco.

General Goethals Reports on First Year of Operation of Panama Canal

Operation of Locks Satisfactory—Waterworks Completed—Death Rate Lowered—Slide Situation Not Covered, as Fiscal Year Ended June 30, 1915

INTEREST in the Panama Canal during the last three months has centered on the slide troubles. As the series of slides which closed the waterway did not begin until late in the summer, they are not touched upon in the annual report, just issued, of the Governor of the canal, Gen. George W. Goethals, covering the year ended June 30, 1915. The report, which is the first since the canal was opened to traffic, deals with the construction, operation, maintenance, sanitation and protection of the canal. Following are extracts from the report:

POWER

The average production cost of current during the last six months of the fiscal year was 0.09 cents per kilowatt-hour, and the average cost delivered from all substations was 0.65 cents per kilowatt-hour. These costs do not include the charge for functional depreciation of 3 per cent of the capital cost of the entire power system. Including this, the costs were 0.44 and 0.99 cents per kilowatt-hour respectively.

The decision concerning size and number of generating units to provide power for the canal was determined in May, 1911, and was based on studies made prior to that date of the probable power demands that would be required. The result of the studies showed a probable day load of about 4000 kw., assuming that the Panama Railroad was not electrified, while if this were done the probable day load was computed at approximately 5000 kw., with one hour's peak of 5700 kw. This assumption was also based on the fact that electric current would be generally used for domestic purposes. Under these circumstances the generating equipment installed, furnishing 6000 kw., allowed for a reserve for future growth of about 1000 kw.

In August, 1912, Congress authorized the construction of coaling stations, drydocks and machine shops, and, though estimates for the probable amount of power that would be required for these purposes were prepared and considered in determining the power plant, the completed designs show power requirements greater than the estimates. Additional demands are made upon the power by reason of the U. S. Navy submarines stationed in the Canal Zone; by the light and power loads at Forts Randolph, Sherman and Grant, and by the new waterworks for the south end of the canal, designed and undertaken since the original studies. The result is that the time is not far distant when additional power will be required, and provision should be made for increasing the capacity of the existing plant and installing a reserve unit. Estimates to be submitted for the latter will include the duplication of the present power house and the installation of one additional unit. Anticipating that an extension might become necessary with time, the penstocks and tailraces were provided in the construction of the spillway during the construction period.

WATERWORKS

The work on the Panama waterworks, which was undertaken during the previous fiscal year, was completed. As previously reported, the original plan contemplated the location of a pump station at Miraflores, utilizing the waters of the lake as the supply; but this had to be abandoned, due to the heavy rise in chlorine in the Miraflores Lake. This pump station, which was nearly completed when the source of supply had to be changed, was remodeled and transferred to the fortification division for use as a storehouse. A station was then built at Gamboa, and the pipe line, extending from Gamboa to Miraflores, was installed during the year. It required the laying of 59,762 lin. ft. of cast-iron pipe, varying from 24 to 36 in. in diameter. The trench was excavated by contract at a total cost of $22,000, and the total cost of the pipe line, including the cost of pipe, fittings, excava- and backfill, was $356,951.10.

The construction of the Miraflores purification plant was about 45 per cent completed on June 30, 1914. The plant was completed and put in operation on March 16, 1915. [See the Engineering Record of Dec. 25, 1915, page 787.] It consists of the wash-water tank, aeration basin, head house, sedimentation basin, filter building and pipe gallery, laboratory and quarters, clear-water basin, and injection chamber. The total cost of the plant was $558,168.41, of which $203,625.12 was for work done during the year. Walks and a roadway were constructed around the plant and the latter was connected with the Canal Zone road to Panama.

The delivery of water from the purification plant at Miraflores to the pump station at Balboa is through three parallel lines, each 21,000 ft. in length, the diameters being 30, 20 and 16 in. respectively; this work was also completed during the fiscal year.

As part of the new waterworks, an extension was made to the existing high-service reservoir on Ancon Hill, at elevation 300, by constructing an addition having a capacity of 1,500,000 gal. This work was practically completed at the close of the last fiscal year.

Three pump stations, one at Gamboa, one at Miraflores and one at Balboa, were constructed, together with the necessary grading and paving and the installation of the machinery and fittings, at a total cost of $200,654.22. The total cost of the new Panama waterworks was $1,387,490.57.

The most important hydrographic feature

of the year was the consumption of water from Gatun Lake for lockages, hydroelectric power and municipal purposes. During the dry season of 1915 about two and one-fourth times as much water was used for hydroelectric power as for lockages, but this ratio is steadily decreasing on account of the increase in the number of lockages.

The elevation of Gatun Lake Jan. 1, 1914, was 84.32, which represented a storage of 180.09 billion cubic feet of water. The total yield for Gatun Lake watershed for the year was 185,686 million cubic feet. The evaporation of the lake surface for the same period was 23,970 million cubic feet, which gave a net yield of 161,716 million cubic feet. Of this amount, 139,285 million cubic feet were wasted at the spillway, 5182 million cubic feet were used for lockages and tests, 3604 million cubic feet for hydroelectric power, 397 million cubic feet for municipal purposes, 265 million cubic feet for suction dredges, and 829 million cubic feet for leakage. Jan. 1, 1915, the lake was at elevation 87, which represented an increase in storage of 12,154 million cubic feet during the year, or a total of 192.24 billion cubic feet at the beginning of the dry season of 1915. During the year 508 lockages were made at Gatun and 502 at Pedro Miguel.

The total yield for Gatun Lake watershed for the dry season 1915 was 43,924 million cubic feet. The evaporation on the lake surface for the same period was 9427.5 million cubic feet, which gave a net yield of 34,496.5 million cubic feet. Of this amount 23,263.5 million cubic feet were wasted at the spillway, 8311.8 million cubic feet were used for hydroelectric power, 3724.6 million cubic feet were used for lockages and tests, 182.2 million cubic feet for municipal purposes, 97 million cubic feet for suction dredges, and 174.4 million cubic feet for leakage. May 1, 1915, the lake was at elevation 86.44, which represented a decrease in storage of 1257 million cubic feet. During the dry season 492 lockages were made at Gatun and 491 at Pedro Miguel.

DRY SEASON RUN-OFF

The 1915 dry season run-off was unusually large. The spillway discharge from the freshets of Feb. 9, 10 and 11, 1915, and April 3 and 4, 1915, alone, had they been stored, would have raised the lake from 87 to 89.95. The direct rainfall on the surface of the lake practically equaled the loss by evaporation during the dry season. No large freshet occurred during the year; there was, however, an unusually well sustained run-off, well distributed as to time.

The total yield from Gatun Lake watershed for 1914 was 102 per cent of the capacity of the lake at elevation 85. The lake elevation has been maintained between elevations 84.75 and 87 by the operation of the spillway gates. In September, 1914, it was raised to 86, and in November, 1914, it was raised to 86.70. From December, 1914, to April, 1915, it was maintained at elevation about 87. Since then it has varied between elevation 87 and 85.50.

During the fiscal year there was an average constant spillway discharge of 5300 sec.-ft.

It has been determined that the Gatun spillway discharge per gate is higher than expected. At elevation 85, the wet-season elevation, one gate discharged 10,460 sec.-ft., an increase of about 20 per cent over what was anticipated. Investigations with velocity current meters show that there are no currents during freshets that will interfere with the handling of ships.

OPERATION OF CANAL

At the close of the previous fiscal year Cucaracha slide was the only obstacle to the passage of ships. During July, 1914, a channel had been dredged through the obstruction 150 ft. wide and of sufficient draft to pass vessels drawing not in excess of 30 ft. The dredges were excavating material faster than it was falling in, and there seemed no likelihood that any further movements at the slide could obstruct the channel. These facts were reported and authority was received to make a trial of the canal by the passage of one of the Panama Railroad ships, which, if successful, would be followed by another to inaugurate the use of the canal by commerce. The ship selected for the trial was the Cristobal, and she made the passage through the canal, with slight delays at Gatun and Pedro Miguel, on Aug. 3, 1914. This was followed by the Ancon, which opened the canal to commerce Aug. 15, 1914. During the balance of the year vessels passed daily, except from Oct. 14 to 20, Oct. 31 to Nov. 4, 1914, and March 4 to 10, 1915, during which periods the canal was closed by reason of the break in the bank which occurred at East Culebra Oct. 14.

Settlement occurred at Gatun Dam, particularly that part west of the spillway over the diversion channel. As this had settled below grade, it was decided in February to raise it to full height, with allowance for future settlement, thereby giving employment to some of the employees whose services would be dispensed with on account of suspension of work on the east breakwater. A total of 67,581 cu. yd. of material, rock on the outside, clay in the center, was placed; rock was procured from the borrow pit west of the dam, and clay from a borrow pit north of the dam.

The Mindi Levee, constructed to keep the discharge from the spillway having access to the canal below the Gatun Locks, was the source of trouble, due to the current of the discharge and to the poor material under and in the levee. During the year 86,199 cu. yd. were dumped on the levee, the material being obtained from the west borrow pit.

MAINTENANCE

The maintenance work on the locks was performed for the most part by the lock operating forces while not engaged in making lockages, and the maintenance of the channels by the dredging division, as already noted.

After the floating caisson was accepted, it was used for unwatering the locks at Miraflores for the purpose of cleaning and painting the miter gates and the rising stem valves. The inspection that was made of the machinery revealed the fact that galvanic action was taking place in the salt water between metals of different kinds. Tests are being made with preservative coatings having insulating properties, and it is hoped that this action can be eliminated. The rising stem valves were coated with bitumastic enamel.

The gate valves and fixed irons of the Pacific locks were painted. Experiments have been made with various kinds of paints, but the most satisfactory coating thus far has been bitumastic enamel, and a contract was entered into with the American Bitumastic Enamels Company to paint all the submerged parts of the lock-gate structures, and maintain them in first-class condition under a five-year guarantee.

LOCKAGES

The time of lockages was reduced and the operations of the various parts of the machinery have met all expectations. Under normal conditions, with both flights in use, the average time for locking through Gatun Locks is 55 min., Pedro Miguel 25 min. and Miraflores 45 min.

As the vessel approaches the locks the pilot in charge is informed by means of an arrow signal the locks that are to be used and their readiness for the approaching vessel; the locomotives are attached, generally four on ships less than 300 ft. long and eight on battleships or ships of exceptional size. The ships are handled through the locks by a lock pilot, who works in cooperation with the towing locomotive operators and directs their movements by signals from the ship. During the lockages the ships' engines are used only to assist the locomotives in starting and stopping the ship. The various operations are under the control of the operators in the control houses, and the course of the lockages is followed by tunnel operators, who stand by to see that all parts of the machinery work properly. Tandem lockages, two ships in the same chamber at the same time, are made, but have been limited in number by the towing locomotives available. Parallel lockages are made only in emergencies, to avoid undue delays to vessels.

The lighting system on the lock walls is satisfactory, and with trained lock pilots no special difficulty is experienced during night operations and no appreciable time lost.

Several instances have occurred where vessels have had difficulty in tying up to the approach piers. At the upper entrance this difficulty has come generally from high winds, especially with ships that do not handle easily. At the lower entrances the difficulty is due principally to the discharge or to currents caused by the meeting of fresh and salt water when the gates are opened. To facilitate the arrival of ships at the lower entrance the gates are left open as long as possible, so that the currents may die out before the arrival of the ship.

The number of lockages made at Gatun during the year was 1216, of which 1066 were for commercial vessels; at Pedro Miguel, 1260 lockages were performed, of which 1085 were for commercial vessels, and at Miraflores there were 1236 operations, of which 1085 were for commercial vessels.

LOWER DEATH RATES

Health conditions were very good. The total death rate was 5.72, as against 7.92 for 1914, and the death rate of disease alone 3.61, as compared with 5.17 for 1914. With regard to malaria, which is our principal cause of disability, the hospital admission rate was reduced 20 per cent, and the death rate more than 32 per cent since 1914. The admission rate for typhoid fever was reduced more than 76 per cent during the year, the admission rate for dysentery 50 per cent, and the death rate for pneumonia more than 39 per cent.

In the Canal Zone the total death rate from disease was reduced from 14.46 in 1914 to 11.77 in 1915; in Panama City from 34.25 to 30.74, and in Colon from 24.12 to 21.25.

Highly Erratic Stream Flow Utilized Efficiently

Hydroelectric Plant on the Salt River Project, Using Only Surplus Flow, Designed for Low Depreciation

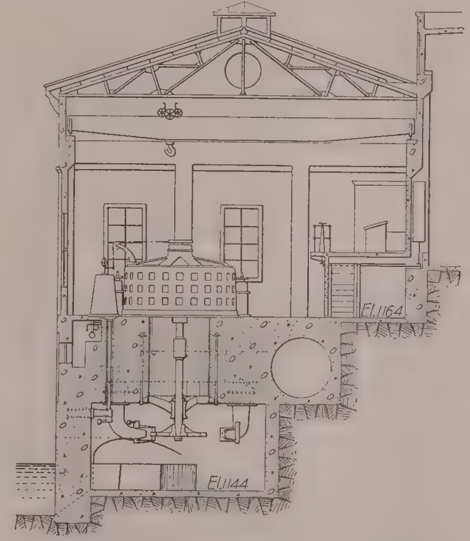
THE Crosscut hydroelectric plant, recently built by the U. S. Reclamation Service on the Salt River project, is designed for operation under a more erratic stream flow, it is asserted, than that at any site heretofore considered suitable for power development. The plant is supplied with water from the Crosscut Canal, a 4-mile connecting link between the Arizona Canal and the Grand Canal, which have a difference of level of about 120 ft. This connection was located so as to concentrate the drop in the shortest possible length of canal in order to make the power available to best advantage. Water is transferred from the higher to the lower canals only under certain conditions of flow in the two systems, so that on some days in the year the Crosscut Canal carries practically nothing and at other times it is full continuously for weeks. The variation in flow, therefore, ranges from zero to capacity, with an average not much greater than 70 per cent of the maximum.

FEATURES CONTROLLING DESIGN

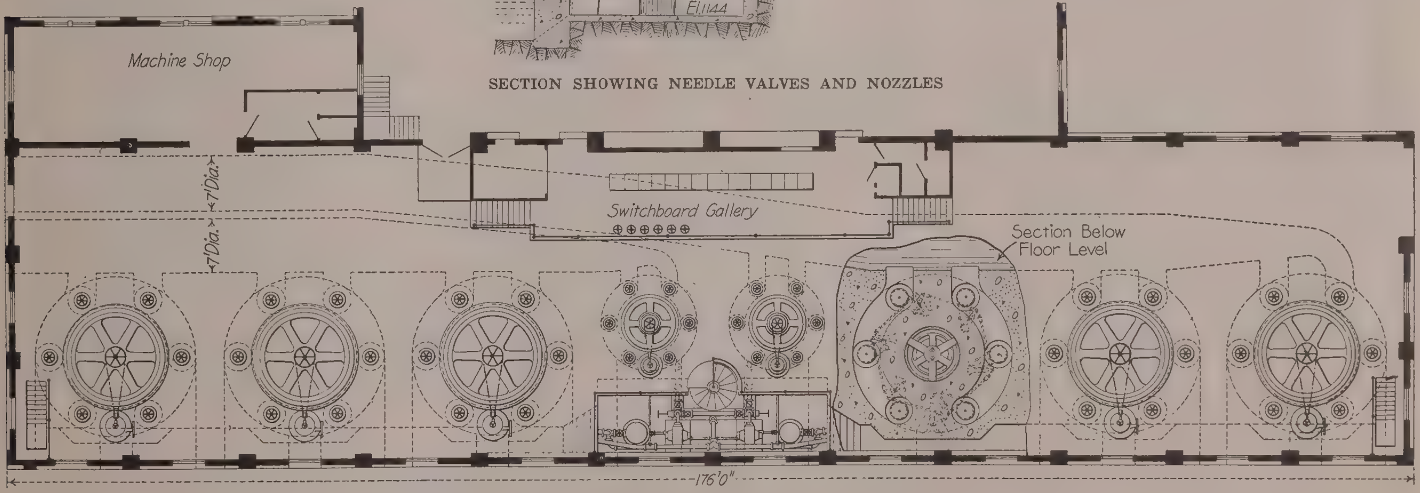
A power-generating capacity totaling about 18,000 kw. has been installed on the Salt River project, 11,000 kw. being at the Roosevelt dam and the remainder in the valley. The valley plants serve as a relay, so that when the rainfall below the dam supplies water for irrigation and the reservoir behind the dam is not drawn upon the valley plants carry all the load possible. Power contracts in effect for years to come take all of the surplus, and the contractors supplement by steam whatever deficiency occurs. Thus it was profitable to build the Crosscut plant to generate as much power as might be economically taken from the erratic flow in the connecting line.

The controlling feature of the design was that the discharge from the waterwheels must equal the erratic inflow at the forebay and at the same time make efficient use of the varying power in this flow. In addition, because the load factor would be low, it was necessary to have the plant so designed that the depreciation would be slight. An obstacle in the way of accomplishing this was that throughout the year 90 per cent of the water carries a very high percentage of silt in addition to the salt and alkali always present, which means the disintegration of any paint or pipe coatings on steel pipe, and the erosion of pipes, wicket gates, wheel runners and shroudings, as well as any synchronous bypasses installed for maintaining constant flow.

Plants operating under similar conditions in the vicinity indicated that a complete renewal of the moving parts of the turbine would likely be required each year, with a corresponding loss of power due to the lowered average efficiency throughout the year. Also, since the pipe line was to be laid on nearly solid rock, a steel pipe would require expansion joints on concrete piers capable of taking up the changes due to the extreme temperature variations. There was also the necessity for a surge chamber at the power house, if turbines were to be used, or synchronous by-passes that would be subject to rapid depreciation.



SECTION SHOWING NEEDLE VALVES AND NOZZLES



PLAN OF HYDRAULIC UNIT ARRANGEMENT, CROSS CUT POWER PLANT

LAYOUT AND EQUIPMENT

For the 2400-ft. force mains it was decided to use concrete, because this material could be bonded to the rock and would compensate for temperature changes by microscopic cracks in the concrete without the use of expansion joints. Also, it was thought that the painting, erosion, rusting and repairs to steel penstocks would thus be eliminated. The flow into the force mains is controlled at the upper end by an 8-ft. butterfly valve, arranged to be opened by hand, but which may be closed in emergencies by stored compressed air from the power plant. The penstocks have an inside diameter of 7 ft. and deliver water to the wheels under an effective head of 111 ft.

Six vertical impulse wheels are installed, each equipped with six oil-operated needle valves. Governing is accomplished by means of stream deflectors, and the water passages from the force main to the individual nozzles are of reinforced concrete. It is asserted that this arrangement provides for permanent connections to the nozzles in a solid mass of concrete beneath the plant floor which cannot depreciate; enables the operator to cut in or out quickly individual nozzles on any unit, and accommodates any stream flow without variation of the working head.

Under this arrangement the efficiency of the unit is the efficiency of each nozzle, and down to one-sixth load the efficiency of the hydraulic end of the unit is at a maximum. Under the working head of 111 ft. the experience of six months' operation indicated that repairs to the nozzles and wheel buckets will be slight and their life indefinitely long. The principal wear comes on the deflectors, which are easily and cheaply renewed. With no water hammer to contend with, no relief valves or surge tank, and with slow-speed wheels subjected to no heavy governing stresses, the operating strains on each unit as a whole are very slight.

Two exciters are installed to supply the six main units. The switchboard is of the double-busbar type and is arranged to include the necessary switches and panels so that it can handle the central switching for the entire valley, including 10,000 and 44,000-volt systems.

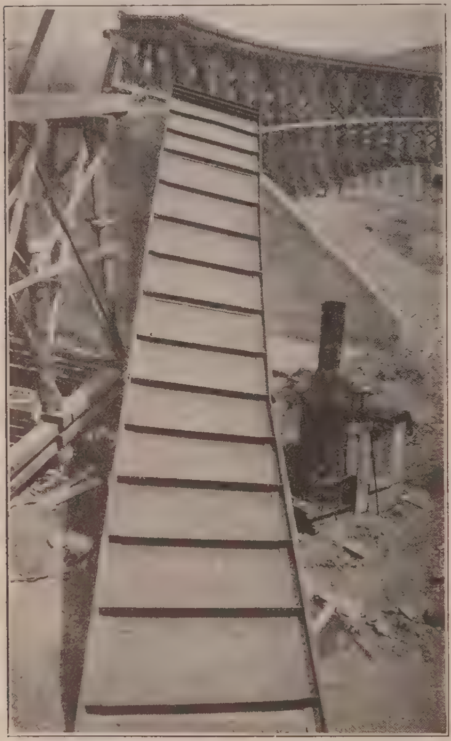
Preliminary tests in controlling the capacity of the plant have shown that an overload of at least 23 per cent may be carried on the individual units. Efficiency tests of the wheels have not yet been made. As the capacity of the plant is limited to the capacity of the canal, and some of the units will be shut down frequently, the nozzles are limited to the normal capacity of the units at the operating temperature. This is necessary because the power-house temperature will be about 120 deg. Fahr. for 24-hr. periods for weeks at a time. It has been demonstrated that but one operator need be on duty at any time, and that his principal occupation will be janitor work. The crew will consist of the general foreman, three operators and one helper.

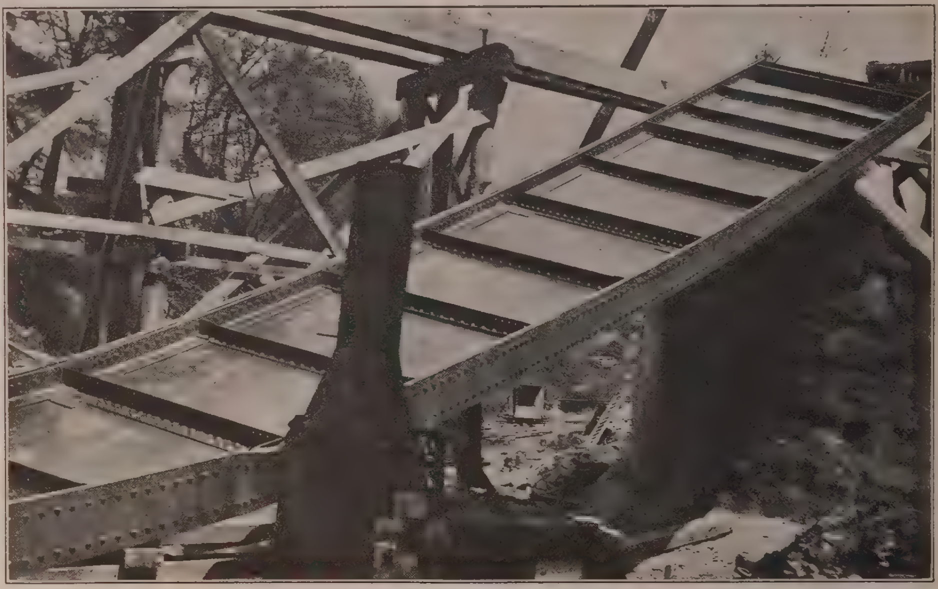
In spite of the extent to which concrete water passages are used, all seepage stopped very soon after operations were begun, it is stated, and in the several months since the plant was started there has been no indication of any further leaks.

The plant has been designed and constructed under the direction of O. H. Ensign, chief electrical engineer of the U. S. Reclamation Service.

A 25-Foot Fall Ruins a 90-Foot Railroad Girder

A NINETY-FOOT girder 9 ft. deep for a railroad spur was recently maliciously pushed from the abutments into the ravine below the track. It fell about 25 ft. on its side and sustained the injuries shown clearly in the accompanying photographs, buckling in several places on both top and bottom chords. In one of the views the rivets are shown missing from a great number of places, indicating more severe injuries than are apparent at first sight. The girder was damaged too badly for further use.


GIRDER PUSHED FROM ABUTMENT IS RUINED


COVER PLATE RIVETS WERE SNAPPED, DUE TO BUCKLING

STEAM ENGINE INDICATORS FOR DETERMINING GOVERNOR EFFORT have been employed successfully in the River Mill plant of the Portland Railway, Light & Power Company. Company engineers working on this problem concluded that simultaneous pressure records, secured on each end of the governor cylinder, form the most satisfactory basis of rating, because under test the conditions are identical with those of normal operation, and elaborate changes of the mechanism are unnecessary. Graphic record pressure gages were used, equipped so as to increase the speed of chart travel and produce a record with appreciable length in the space required for the governor to operate through a considerable part of its travel. Charts were taken from indicators on each end of the governor cylinder so as to secure a continuous record on the cards of the varying pressures from each side of the governor piston throughout two complete strokes or one cycle of operation.

Experts Testify on Means of Eliminating Odors in Garbage Reduction

Suit at Springfield, Mass., Evokes Opinions Regarding Best Methods of Treating Foul Gases from Digester Tanks

BEFORE Hon. Samuel D. Conant, special master, a suit has recently been heard at Springfield, Mass., bearing upon the operation of a garbage reduction plant by the Springfield Merg Reduction Company. The complainants were Jones et al who endeavored to secure relief from odors disseminated in a residential district adjacent to the installation. The plant was completed in the early part of 1913 on the basis of a contract with the city which requires that the gases from the digesters shall be burned. The burden of the expert testimony presented was that this method does not guarantee freedom from odors, but that substantial immunity might be gained through scrubbing and susbequent treatment with chloride of lime. Recent developments of the Cobwell process were also discussed as of interest in this connection. Extracts from the engineering testimony in the case are given below.

EQUIPMENT OF PLANT

The plant is located in the eastern part of the city near the Springfield almshouse and approximately 2.5 miles from the business center. It contains five digesters of the tilting type, a steam boiler plant, conveyor system, tanks, and other equipment common in this class of service. The distinctive feature is the provision by which the digesters revolve on horizontal trunnions to facilitate emptying the material after cooking. The attempted destruction of digester gases by burning is also unusual.

In ordinary operation about 9 tons of garbage are treated daily in each digester. Pressing is accomplished by steam and an auxiliary press has lately been added. The usual production of grease and fertilizer is the result of operation. The installation provides for burning the digester gases in either an oil furnace or in the boiler furnaces, or in both together, and the plant has a chimney 50 ft. high. The main building is 86 ft. long, 60 ft. wide and 38 ft. high, with a boiler house one story in height, 27 x 44 ft., equipped with two 60-in. horizontal return tubular boilers designed to operate at 100 lb. per square inch, 80 lb. being used in practice. An 80-hp. non-condensing engine drives an electric generator furnishing energy to various motors in the establishment, and the lighting is supplied from this unit. The cost of the plant was about $90,000, including various alterations designed to increase its efficiency and diminish the odors.

Since the plant was opened for service various improvements have been made. An additional tank to enable excess collections to be cared for was installed and the practice of pressing into a sealed tank was modified by the installation of catch basins, so that the water pressed out from the tanks no longer passed directly into the sewer, but was allowed to settle and cool, diminishing the odors in the sewer and enabling more grease to be recovered. The original oil furnace for burning the digester gases was found to be too small, and was enlarged. Attempts were made to dry the tankage in part, but the practice was abandoned because the existing form of drier was inefficient and the driers appeared to increase the gases.

At first some of the digesters did not press satisfactorily, due to clogging of the strainer plates on the inside. This was remedied by changing the plates, making larger perforations and in some cases installing screen wire over the plates on the inside to prevent clogging. A secondary press was added because it was found that a longer time was required to press than at first appeared likely. E. G. Whittemore, superintendent of the plant, testified that the use of the driers was discontinued on account of odors. Another improvement was the relocation of a burner away from a party wall in the fire room on account of its affecting the wall. There was also installed a pressure tank for fuel oil, the piping was changed to permit alternate or simultaneous burning of gases from the digesters in the oil-fired retort or in the boiler furnaces, and other minor improvements were made.

TESTIMONY ON ODOR REDUCTION

Irving Blount, consulting engineer, New York City, testified that the principal odor in garbage reduction plants arises from the digester process, the local odors due to raw garbage, water after pressing, tankage or dirt being less pervasive. The witness doubted the efficacy of fire alone as a means of destroying the odor of the digester gases, and held that better results might be secured by condensing the steam vapor from the cooking garbage in a surface condenser. Jet condensing, the witness thought, would not be as well adapted to an inland town on account of the scarcity of fresh water supply. It was recommended that the condensed vapors be treated with chloride of lime, the final gases discharged being freed from their offensive character by the action of the chlorine. The soluble gases would pass through the same water solution and be deodorized. The estimated cost of installing such equipment at the Springfield plant was approximately $3,000.

The witness stated that about three years ago he had made experiments along this line at the plant of the then New York Sanitary Utilization Company. A pipe was run from the vent of the digester to a set of submerged coils, the condensate then being passed through a chloride of lime solution. None of the plants of either the dry process or reduction types visited by the witness in this country discharged the digester gases into the furnace as in Springfield. In all the other cooking plants the gases are condensed with water. The purpose of the jet condenser in practice is to condense the soluble gases and to cool the insoluble gases, the cooling effect being to limit the odor arising from the latter to the proximity of the plant. The opinion was advanced that the action of fire on the digester gases probably changes their chemical form and may produce other compounds of a disagreeable character. From an economical standpoint condensing by water appears superior to the attempted deodorizing of gases by fire.

From the standpoint of efficiency the practice of attempting to burn the digester gases in the boiler furnaces was criticised on account of the securing of a forced draft in such cases by resorting to a steam jet. On elevated ground a plant can be placed nearer a residential district than in a depressed section. The scrubber installed at Springfield is not used to scrub the digester gases but to scrub the gases collected from the plant interior. The stick water is passed into the sewer, but does not have an offensive odor unless allowed to stand in the catch basin 48 hours, when fermentation sets in. The effluent water from a plant the size of that in New York totals 200,000 gal. per day, but when passed away directly in its first condition and cooled off no perceptibly disagreeable odor results.

CONDENSERS FOR DRIER GASES

Next to the digester system the greatest volume of objectionable gases that are produced by these reduction plants comes from the driers, on account of the large amount of air necessary for drying. The use of a condenser to destroy the local gases collected in the building appears practicable. At Springfield the local room gases are exhausted under the fire after being sprayed. Craft claims that sulphur dioxide gas is not totally soluble until after it has been heated up to a certain temperature sufficient to change the chemical composition. The height of stack necessary depends on the draft required for the boilers and not upon the requirements of gas dissemination.

Regarding the chloride of lime process, Mr. Blount said that this material costs from 1.5 to 1.75 cents per pound and that about 4 parts available chlorine to 1000 parts water is sufficient to deodorize the gases. It would be feasible from the engineering standpoint to turn the gases from the Springfield furnaces into a surface condenser. The Springfield plant is one of the smallest plants in the country, while that in New York has 172 digesters of 10 and 15 tons' capacity and reduces a maximum of 2500 tons in a day. At Springfield the digesters are filled to within about 3 ft. of the top, and from 70 to 80 per cent water is present in the material. The vapor is carried to the furnaces or retort through ¼-in. vents, one from each digester. About 90 per cent of this vapor is water. The witness agreed that odors from such a plant might be noted at a distance of ½ mile.

COBWELL PROCESS DESCRIBED

William J. Springbaum of New Bedford, Mass., manager of the reduction plant in that city, described the application of the new Cobwell process, invented by Raymond Wells, of Homer, N. Y. An experimental unit of this system was installed at New Bedford in May, 1914, and after one year's trial was taken out and replaced by six new units. The process consists of placing the garbage, delivered by wagons, in a sealed, jacketed tank. After the tank is sealed, a solvent (gasoline) is pumped into the material and steam is turned into the jacketed tank, but the steam does not come into contact with the garbage. The steam is turned on long enough to boil or set in motion the solvent and water inside. During this period the material is stirred by an agitator so as to thoroughly mix the solvent and garbage. The solvent vaporizes and so does the water in the garbage. The two vapors then combine and pass through a pipe to the condenser, and are then again restored to their liquid state by cooling. The water and solvent, having different specific gravities, are separated, the solvent being drawn off at the top and after being returned to storage tanks it is used again. The water that has been boiled out of the garbage, having just a trace of foul smell to distinguish it from ordinary water, perfectly clear and carrying no solids, is then run off to the sewer. No insoluble gases are created, because the garbage is not decomposed as in other systems. A corn husk comes out similar to a shoe lacing, in the shape of a long, stringy material. No pressure is used in this system above 2 lb. per square inch and operation in a vacuum would give still better results. The bad odors are entirely eliminated, and boiling takes place at the point where the vapor pressure from the solvent and the vapor pressure of the water combine, viz., at from 190 to 196 deg. Fahr. The garbage disposal plant at the Panama-Pacific Exposition is of this type.

Relative to the possibilities of disposing of odors through heating, Mr. Springbaum said that heating dries the vapor or gas to a degree that it becomes much lighter than air, and until mingled with air long enough to become saturated again hovers some distance above the stack. As soon as there is sufficient moisture in the atmosphere to load the gases again, they fall to the earth, and an odor can be detected. The witness favored condensation and treatment with chloride of lime for the Springfield plant, but preferred the jet type of condenser on account of the first cost and maintenance of a surface type for such service. Acids or gases in digester vapor are destructive to piping and would be likely to lead to excessive maintenance costs in a surface condenser. About 32 lb. of water are required to condense 1 lb. of steam in a jet equipment compared with 45 lb. in a surface equipment. About 75 per cent of the objectionable odors now noticeable at a distance should be destroyed by this treatment. Entire freedom from odors under all conditions is practically out of the question.

The cost of changing over the Springfield plant to operate under the Cobwell process would be from $35,000 to $40,000. The cost of removing the present Springfield Merg plant to another site would be perhaps 90 per cent of the initial outlay already made. The witness said that he had detected odors 3000 ft. from a Cleveland plant installed under his direction, under certain atmosphere conditions, with a stack 60 ft. high through which nothing passed but the vapor from the driers or cookers.

WOULD ELIMINATE STACK

In designing another furnace Mr. Springbaum said that if he had a stack he would lay it flat on the ground and would simply use a mechanical fan to draw or force the gases through the furnace and saturate them with water at every foot of their travel, allowing them to escape on the ground at the back and localizing instead of sending them abroad. Scrubbing is an essential part of a successful process, since so large a proportion of the vapor is moist and condensable. In digesting garbage a plant accomplishes in 7 hours what nature does in 7 weeks. The witness thought that scrubbing the gases before burning would help somewhat at Springfield, but that scrubbing after burning would not eliminate the gases. Mr. Springbaum said that a better location for a garbage plant is in the manufacturing districts, near railroad yards and in places where there is less objection to wagons passing through the streets. The bulk of garbage in any city is produced in its heart, and unnecessary cartage is also objectionable.

Called to the stand at the final session, Mr. Whittemore said that in theory the process of filling, cooking, floating off grease and pressing in one tank is excellent, but that in practice an unusual amount of work is entailed by this arrangement, involving considerable extra labor and loss of time.

WATER FOR ROAD SPRINKLING is piped 12 miles on the ridge route recently constructed by the California Highway Commission to connect Los Angeles and Bakersfield. The road is built at a high level in a naturally dry district, and in order to avoid pumping, the long pipe lines were laid to bring spring water to a series of five reservoirs at as many different "high points" on the road profile. The reservoirs are excavations lined with concrete.

Two Relief Gates Considered for Handling Cross-Canal Flood Waters

Experimental Installations Now in Service Will Determine Which Type Will Be Adopted for Long Ditch

By Joseph Jenson
Consulting Engineer, Salt Lake City

MANY irrigation canals, especially in the Rocky Mountain states, are built along the base of a mountain range for the purpose of supplying irrigation water to a long but comparatively narrow strip of bench land lying between the mountain range and the low lands of the valley. One of the perplexing problems which confront the engineer in such cases is to take care of the cross-canal waters which come from sudden violent rainfalls or rapidly melting snows in the mountain range above the canal. To handle these waters successfully the two types of gates herein described were developed.

Piute Main Canal

An aggravated case with cross-water troubles which has recently come within the experience of the writer is the main canal of the State of Utah Piute project. This canal is situated along the base of the western range of mountains in the Sevier Valley, in Sevier and Sanpete counties. The canal has a length of about 55 miles. The transverse slope of the country varies from about 3 per cent to as steep as one in two. The capacity of the canal at the head is 500 cu. ft. per second, decreasing gradually to 300 cu. ft. in 40 miles and thence to 60 cu. ft. in the remaining 15 miles. In the stretch of 55 miles the canal crosses more that one hundred canyons and washes, emerging from the mountain range on the west. All of these have been provided with either under or over-canal channels to convey water across the canal. These canyons and washes are for the most part dry; that is, they do not contain a permanent stream. All are subjected to heavy and sudden floods due to violent local storms in the adjacent mountains.

A calculation of culvert capacity by the common rules based upon the area of the watershed and precipitation records would be entirely misleading and inadequate in this case. So also, observation of the old water channels in these canyons do not furnish a criterion on which to base a rational design for culverts. Some washes whose channels have grown up with brush and show no signs of having had for years streams of any considerable size have suddenly been transformed into raging torrents, usually of not more than one or two hours' duration. These floods carry with them great quantities of debris, large boulders and trees. Not infrequently the breast of such floods consist of a great rolling mass of debris several feet high, resembling more an avalanche than a flood. It is not uncommon that as these emerge from the usual narrow gorge onto the alluvial cone the original wash or channel is completely clogged and the rushing torrent must find a new course to the valley. A culvert or overshot on the canal at the original crossing, even if adequate should the flood follow its old course, is not infrequently rendered useless. Attempts to maintain a permanent channel for these flood waters or to protect the canal by embankments along its upper edge have proved equally futile as a permanent safeguard.

Floods at Height of Irrigation Season

To aggravate the situation, the floods are most frequent and of greatest violence during the latter part of July and August, just when irrigation is most urgently needed and the canal is carrying full capacity. Any considerable amount of water entering from extraneous sources is an overburden, and not only results in damage to the canal, but also in shutdowns for repairs when the crops are in greatest need of water.

These conditions led to the plan of providing relief devices whereby the canal could quickly and effectively be relieved of its load so as to allow it to carry during a flood interval up to its full capacity such water as may enter it laterally and thereby lessen the probability of disastrous breaks. Two such devices were designed and installed by the writer. Both are experimental in character and only one of each has been built to date. It is obvious that to afford protection to the entire length of canal a number of such devices will be needed at intervals along the canal. Which one, if either, of these structures will be adopted will probably depend upon the experience with these trial installations. The devices contain some features of design which, so far as the writer is aware, are novel, and are here presented in sufficient detail to make these features clear.

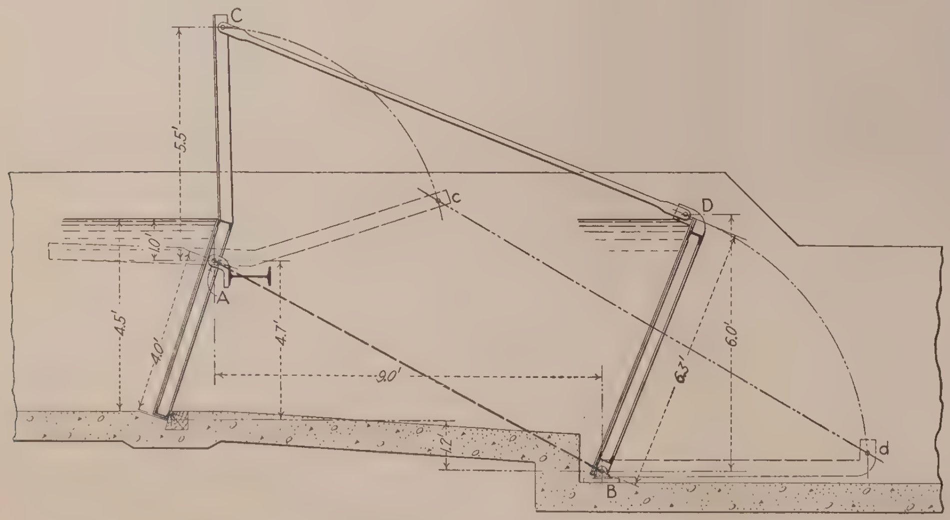


FIG. 1—THIS GATE AUTOMATICALLY ALLOWS SURPLUS WATER TO BE DISCHARGED

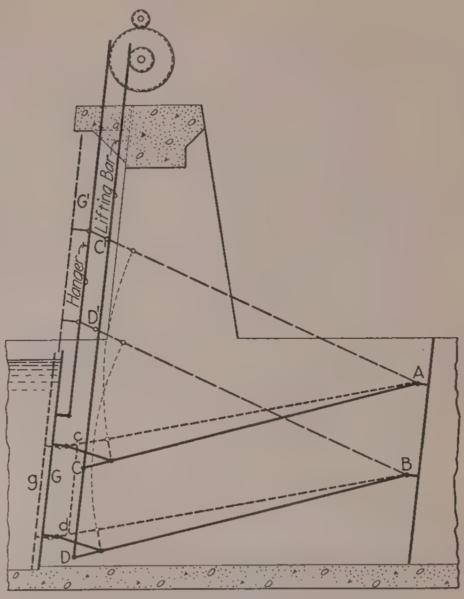


FIG. 2—ILLUSTRATING PRINCIPLE OF WINCH-OPERATED GATE

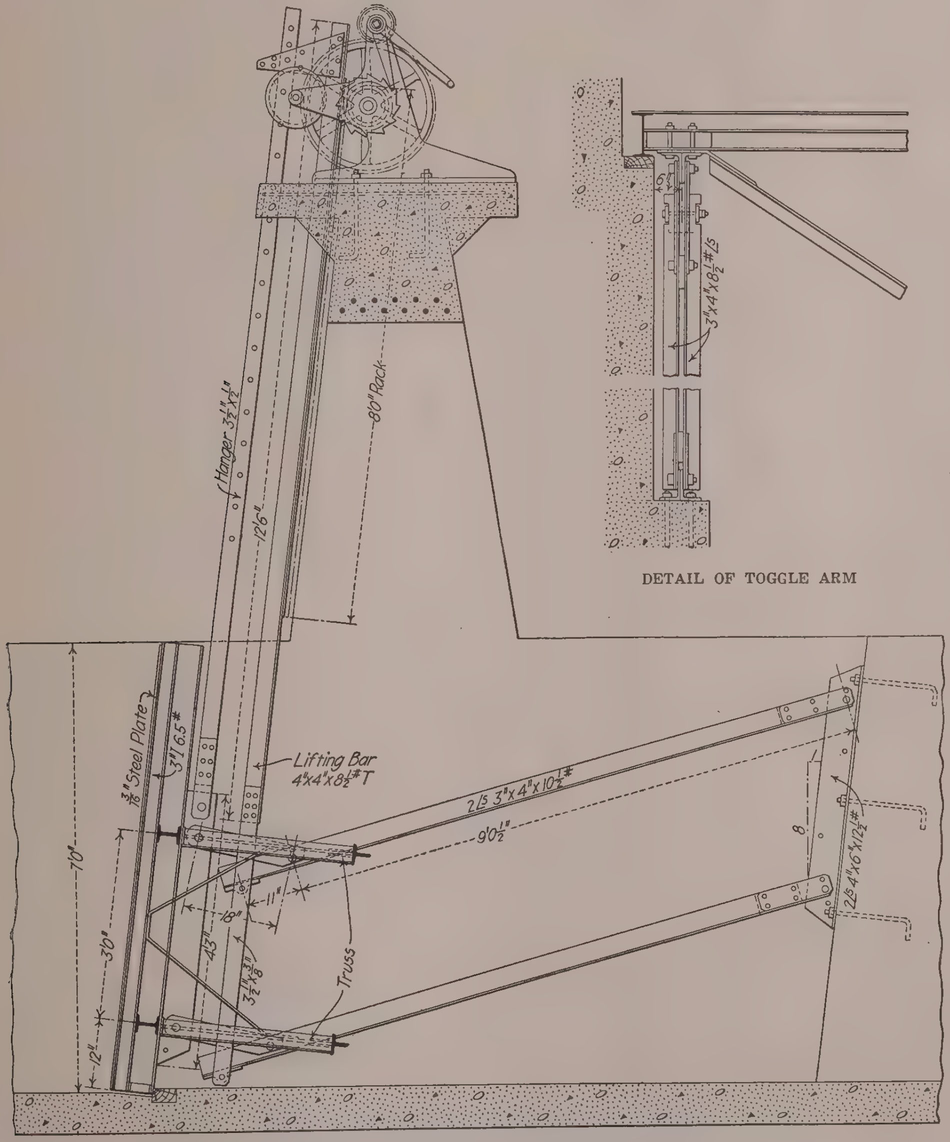
First Design

The first, Fig. 1, is intended to be automatic in operation. It consists essentially of a pair of hinged gates, set in a reinforced concrete box extending through the lower bank of the canal and communicating thence with a waste channel to the natural drainage course of the valley. The first gate is hung on a horizontal I-beam extending across the gate box about one-third the depth below the maximum high-water surface in the canal. The gate itself consists of a frame of T- and channel bars, with a sheet-steel skin on the canal side. The vertical members of the frame are extended as shown to form lever arms. These are connected by means of a corresponding set of links to the upper edge of the second gate. The latter is built on the same general plan as the first gate, except that the vertical members are provided with a hinge connection at the lower instead of the upper end. A vertical step in the bottom of the channel, immediately in front of the second gate, provides the extra pressure required on the second gate to operate the mechanism and also allows the gate to drop below the current when the gates are open.

The first gate when closed is seated both at the sides and bottom and swings away from the seat when in operation. The second gate is hinged at the bottom and swings free, no attempt being made to make a water-tight joint either at the bottom or the ends. The first gate when closed prevents leakage from the canal. Any leakage around the second gate when water flows over the first is of no consequence.

Operation

The combination forms a common "four-bar linkage," A-B-C-D, the heavy dotted line constituting the stationary link. When an excess of water enters the canal the water overflows the upper edge of the first gate. As the elevation of the water in the box approaches that in the canal, the whole mechanism swings into the position shown by the light lines and the waste channel is open to relieve the canal not only of the excess water, but of its entire flow. The calculation for proper dimensions is simple and is not here given. The dimensions in Fig. 1 will enable anyone familiar with elementary mechanics to check the results and show that the pressure on the second gate is sufficient to overcome the pressure on the first, even without taking into account the back pressure on the first gate due to the filling of the box behind it.



DETAIL OF TOGGLE ARM

FIG. 3—WINCH-OPERATED GATE FOR SAME SERVICE AS AUTOMATIC GATE, FIG. 1

It is apparent that this device is not adapted to hand operation. This, however, may be facilitated by placing in the body of the first gate a small hand-operated sluice of sufficient capacity to fill the box between the gates.

SECOND DESIGN

The second structure, Figs. 2 and 3, referred to above is intended to be a power-operated device. It is a single gate, which, as installed, is 7 ft. high by 28 ft. long. It is constructed on a T and channel-bar frame, which in turn is supported on two steel trusses, so spaced vertically that each truss will sustain one-half the water-pressure load when the canal is carrying its maximum normal flow. The gate when closed is fully seated in the usual way both at the sides and the bottom. About 10 ft. back of the gate on each side of the concrete channel in which the gate is set is an off-set in the wall to which a thrust plate is anchored. Each end of each truss is connected to this thrust plate by means of a toggle-joint link consisting of one long and one short member, the short member joining onto the gate truss. These links are designed to sustain safely a column action equal to one-fourth the total water pressure on the gate. The long member of the link is continued beyond the hinge to a point near the back of the gate and there connected in vertical pairs by means of a halter to the lifting bars, one at each end of the gate, and geared to a pair of winches, driven by an electric motor, both from the same shaft. As is evident from Fig. 2, the first action of the mechanism is to straighten out the toggle joint and thrust the gate forward to the position shown by the dotted lines. The gate is now free from its seat, and the continued action of the lift is to swing the gate without sliding friction, into the position shown by the dash lines, and the gate opening is completed.

The motor is thrown into motion by closing a switch in the office of the canal superintendent. Its motion is discontinued by pulling a switch automatically at the gate end of the line when the gate has been raised its full height. A pawl and pawl-wheel secures it from slipping back. To close the gate it is necessary to keep the toggle in line until the gate is completely lowered. In order to do this a second bar, called the "hanger," is fastened directly to the gate and extends above the bridge alongside the lifting bar. By slipping a pin through this and a shoe fastened to the lifting bar the toggle is locked in line and the links on each side become a simple parallel four-bar linkage. The gate may now be lowered without contact with the gate seat. When the gate is completely down the toggle is unlocked and the gate seats itself. The gate is lowered by simply raising the pawls, applying a simple brake and allowing the gate to slip down of its own weight. In order that the gate may be used at part opening a series of holes is punched in the hangers so that a pin may be slipped in, hanging the gate at any desired stage. When the gate is thus hung the toggle may be unlocked and the gate seated.

The elements of the mechanism are shown in Fig. 2. The details of construction, not including the motor connections, are shown in Fig. 3.

WIDE OPENINGS SECURED

One other matter which was taken into account in the design of these structures remains to be mentioned. Vacant land on both sides of the canal produces a prolific growth of Russian thistle or Tumble weed. During certain seasons great numbers of these roll into the canal. They show a wonderful tendency to attach themselves to any obstruction, such as piers or posts, in the canal and thus interfere with the flow of water. This made it desirable that canal structures should have clear, wide openings, such as these designs possess.

In conclusion, it is proper to state that the writer does not claim to have effected a final solution of the problem herein set forth, but submits his experience in the hope that others will add to the discussion.

TWELVE THOUSAND FOREST FIRES, large and small, occurred in Canada during the spring, summer and fall of 1915, according to the report of the Canadian Forestry Association. This represents an average of 1400 a month for the season. Settlers' fires caused 35 per cent of the losses in British Columbia, Ontario, Quebec and New Brunswick, it is estimated. In British Columbia "permit laws" are enforced by which all settlers are obliged to obtain the supervision of a forest ranger before setting out their clearing fires, and while 10,000 acres of logged-off land were burned, the fires were kept out of all but 36 acres of merchantable timber. Manitoba suffered a loss of $1,000,000 by forest fires which burned approximately 80,000 acres during the dry season. In the province of Saskatchewan the damage is estimated at $170,000, with a burned area of approximately 140,000 acres. In southern Alberta, thanks to the heavy rainfall, the fires have been comparatively small, only about 25,000 acres having been burned over, suffering an estimated damage of $1 per acre. In the Peace River valley, where the season was dry, many destructive fires occurred.

Literature

For the Civil Engineer and Contractor

The Construction of the Panama Canal

Authors, William L. Sibert, brigadier general U. S. A., and John F. Stevens, formerly chief engineer and member of the Isthmian Canal Commission. Cloth, 239 pages, 23 illustrations. New York, D. Appleton & Company. $2.

This book gives an excellent idea of the design and construction of the Panama Canal, without going into wearisome details. It is intended for general reading rather than as a reference book for the technical man.

It is divided into two parts: the first discusses the preparatory period, from 1904 to March, 1907, and the second the construction, from March, 1907, to April, 1914. The first part is written by Mr. Stevens and the second by General Sibert.

An idea of the scope of the book can readily be obtained from the chapter headings, which are as follows: Preparatory Period—Sea Level vs. Lock Type of Canal, Reconstruction of the Panama Railroad, Prosecution of the Work, Development of Working Plans, Housing and Feeding of the Force, Assemblage and Management of the Force. Construction Period — Adopted Project, Changes in Adopted Project, Changes in Dimensions of Parts of Canal, Designs for Permanent Buildings and Locks, Construction from Colon to Gatun, Excavation and Concrete Work at Gatun, Construction of Gatun Dam, Gatun Lake, Construction from Gatun to Pedro Miguel (Culebra Cut), South End of Culebra Cut to the Pacific Ocean, Municipal Engineering, Shops and Terminal Facilities, Operation of Panama Canal, The Work and Its Cost.

Because of General Sibert's intimate connection with the work in the Atlantic Division, the construction there is treated at somewhat greater length than that in Culebra Cut and on the Pacific side. The general features, however, are stated with reference to all of the work. Passing incidents that have a human flavor are worked in, particularly by General Sibert, making the volume even more readable than a mere recital of facts could make it.

Ford Methods and the Ford Shops

Authors, Horace Lucien Arnold and Fay Leone Faurote. Cloth, 7 x 10½ in.; 440 pages, illustrated. New York, The Engineering Magazine Company. $5.

This is a volume which while devoted chiefly to the production methods of the Ford shops, should be of value and interest to every industrial engineer, even though his work be the designing of the structures only. The influence upon them of the operations they are to house is necessarily large, and this book shows how the intensive work of the remarkable Ford shops is carried on. As is known in a general way, remarkable special machines, working routine and management system have been developed by the Ford organization. An understanding of them is well worth while, even if for the mere purpose of keeping in touch with the progress in manufacturing methods.

One chapter is devoted to the new Ford factory buildings and to the factors which influenced their arrangement and design. A final chapter on methods for safeguarding the workmen contains some information regarding fire protective devices and danger warnings. It includes a full treatment, too, of the protective devices used in connection with moving machinery.

The Building Estimator's Reference Book

Author, Frank R. Wallace. Limp leather, 4½ x 6½ in.; 612 pages; illustrated. Chicago, published by the author, 30 Michigan Avenue. $10.

Estimating costs of modern buildings is a highly specialized science which requires either large experience or exact data. The author of this 612-page book has compiled data taken from his own experience and the best available sources of reliable information. Realizing the vital influence of the local conditions on the costs, special emphasis is placed on complete description and illustration to explain all the items of methods and plant which affect the work. Inside figures of costs are sometimes given for buildings which have not been mentioned by name because the information was confidential.

Costs are given in actual hours per unit of measure, so that the data can be used with any prevailing local rate of wage.

After considering general conditions and overhead expenses, the author gives costs of wrecking and excavating, caissons, concrete, wood and sheet piles and concrete for foundations. The next two chapters consider waterproofing and concrete floors and pavements, mainly by the citation of examples. Reinforced concrete and reinforcing steel are similarly treated, followed by brick masonry, stonework, fireproofing, rough carpentry for timber framing, flooring, etc., mill work and interior finish, including plastering, doors and windows, art metal and sheet metal.

Slate, tile and composition roofing and felts are treated in one chapter, followed by chapters on exterior and interior marble, slate and scagliola, tiling, glass and glazing, painting and varnishing. Structural iron and steel costs are given in a chapter of 27 pages. Building specialties (including vault doors, prismatic sidewalk lights, blackboards, etc.), hardware, plumbing, steam and hot-water heating and electric wiring are considered in the concluding chapters.

Elasticity and Resistance of the Materials of Engineering

Authors, William H. Burr, professor of civil engineering, Columbia University, New York City. Seventh edition, thoroughly revised. Cloth, 6 x 9 in.; 928 pages. New York, John Wiley & Sons. $6.50 net.

Reviewed by F. H. Constant

Professor of Civil Engineering, Princeton University.

The present edition has been completely rewritten and re-arranged, much of the older matter has been displaced by new topics of greater present practical importance, and a new book has virtually been created. Although smaller than the last edition, it still contains 928 pages. To those familiar with the older editions, a list of the chapter headings will indicate the character of the revision. The subject matter is still classified under two parts, devoted to the analytical and technical aspects of the work respectively.

Chapter 1, "Elementary Theory of Elasticity," has been expanded from 13 to 50 pages and now includes the ellipse and ellipsoid of stress. Chapter 2, "Flexure," replaces the old chapter 3 on this subject, and is much enlarged. Chapters 3 and 4, on torsion and on hollow cylinders and spheres, have been rewritten.

Part II, "Technical," contains many tables and much practical data, and has been almost completely rewritten in order to bring it up to date. Chapters 7 and 8, "Tension" and "Compression" respectively, take up in order cast iron, wrought iron, steel, copper, cement and timber. The specifications for the steel of the Manhattan Bridge in New York are included. Forty pages are devoted to riveted joints and pin connections in chapter 9. In chapter 10, "Long Columns," the new matter includes the principles of the moments of inertia, a new treatment of Gordon's formula, new column sections and recent tests of various steel columns, with the typical formulas now in use. Chapters 11, "Shear and Torsion," and 12, "Bending," contain much tabular data of recent tests.

Much interest will center upon the author's treatment of concrete-steel members in chapter 13. It contains 70 pages and covers the theory and practical application of this form of construction. In this field Professor Burr was one of the earliest writers, and he has contributed much to the development of the present rational and simplified methods. It is to be regretted that he did not finally adopt the notation now generally used in practice, and most familiar to engineers.

In flexure the most general case is treated first; viz., that of the T-beam with steel on both compression and tension sides. The tensile resistance of the concrete is included, and the neutral axis is assumed to lie below the flange. When the various practical conditions are introduced, such as steel on the tension side only, tensile resistance of concrete neglected, and the width of flange assumed equal to the width of web (the case of the ordinary rectangular beam), the formulas reduce to the familiar simple expressions used in practice. A study of this general analysis, although it involves some superfluous terms and seemingly complicated mathematical expressions, should result in a sound knowledge of the mechanics of the composite beam.

The practical value of this part of the book would be greatly enhanced if the author were to include tables and diagrams to expedite the use of the formulas.

The author recommends that the entire transverse shear be provided for by steel stirrups or bent rods independently of the shearing resistance of the concrete. These steel rods are treated like the diagonals and verticals of a Pratt truss, the stress being obtained by multiplying the total transverse shear by the secant of the vertical angle, the spacing of the bent rods or stirrups being limited to the depth, or preferably three-fourths of the depth, of the tensile steel. In computing the value of bond shear for the stirrups, the author allows the use of the entire length of stirrup instead of only the part lying above the neutral axis.

The confusion in the present methods of establishing the working stresses in reinforced-concrete columns is again apparent. In column tests the yield point of the longitudinal steel and the ultimate strength of the concrete are reached at about the same time. Should the working stresses be based upon the ultimate strength of the column or upon the stress conditions existent at the time when the working stresses occur? The author uses the former method and recommends the high unit of 16,000 lb. per square inch for the steel, while retaining the A. S. C. E. specification of 22½ per cent of the ultimate strength of the concrete, about 500 lb. per square inch. It is impossible, of course, for these working stresses to exist side by side, their relative values being determined by the ratio of their moduli of elasticity at any time. For this reason many engineers prefer to use units that are consistent with each other at the working load, employing a much smaller value for the steel even though the allowance in the concrete (especially when well banded), is sometimes increased over that recommended by the American Society of Civil Engineers.

Chapter 14 covers rolled and cast flanged beams. Chapter 15, "Plate Girders," is rewritten and includes the complete computations for a 70-ft. single-track railway deck plate-girder span in accordance with the A. R. E. A. specifications. Chapter 16, "Miscellaneous Problems," includes a number of new topics, such as curved beams, hooks, eccentric loading, general flexure by the core method, oblique flexure, elastic action in a composite material, helical and plane spiral springs, flat plates, and the theory of least work applied to a bridge portal. Chapter 17, "Fatigue of Metals," and 18, "Flow of Solids," as well as the three appendices covering the mathematical theory of elasticity, thick hollow cylinders and spheres, and the theory of flexure are, in the main, unchanged. Some new matter, including Clavarino's formula and the resisting capacity of natural and artificial ice, is introduced at the end of the book.

Some typographical errors have crept in, equation 3 on page 662, for example, containing two. The author is not always consistent in the use of his symbols.

This classic work has long been regarded as the leading American authority in the field of the elasticity and resistance of materials. It is a source of gratification to the engineering profession that Professor Burr has been willing to undertake the arduous task of revision, and has completed this work in so thorough and satisfactory a manner.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Why Is Registration in Civil Engineering Decreasing?

SIR: The decreasing enrollment in our engineering schools as noted in the Engineering Record of Dec. 18, 1915, has been a matter of interest to the writer for several years. The enormous increase in the number of engineering students from 1890 to 1910 could hardly have been expected to continue, and the subsequent decrease should cause no alarm. It is but the natural result of deep underlying economic conditions.

First of all, the figures for 1915-16 should be discounted because of the depressed financial condition of our own country as well as of Latin America and the Orient, from where we have been drawing large numbers of students. In this connection, figures of a large Eastern university before the writer show marked decreases in number after the depressions of 1893 and 1907. Omitting these figures then, a glance at the curves shows that the decrease had reached its maximum effect some three years ago, the curves being horizontal for the following years.

There are a number of reasons for the general falling off in numbers. An examination of statistics of leading universities will show an increasing interest in agricultural courses for the past decade or two, far surpassing any similar period of expansion of the corresponding technical departments. In the case of the university referred to, the greatest increase in engineering students for a ten-year period was from 1899 to 1909, namely from 950 to 1900. In the case of agriculture the increase from 1904 to 1914 was from 189 to 1670.

The deluded popular notion concerning reward for technical ability has gradually been dispelled by actual statistics, as for example, the recent figures compiled by the American Society of Civil Engineers, resulting in the search for greater remuneration along other lines of endeavor.

Nor can it be overlooked that with the development of the profession the technical schools have been raising both their entrance requirements and their standards of work. The result in numbers is evident. The introduction of six and seven-year courses with less time spent in the engineering college also has a slight but misleading effect upon enrollment statistics.

Finally, a number of factors combine to decrease the enrollment for individual schools, but which if anything have the opposite effect upon the total number of engineering students in the United States. Among these may be mentioned the establishment of new schools, the expansion of others hitherto unrecognized, the introduction of night courses leading to a professional degree, and finally the development of correspondence courses.

It is the belief of the writer that a stable, healthy condition has about been reached which will result in a supply more suitable to the demand; for while the increasing participation on the part of the engineer in public and executive duties may cause the curves to ascend in the future, an ascent as steep as that of ten or fifteen years ago is unwarranted.

CHARLES WEISS, C. E.

Pittsburgh.

SIR: I read the article and editorial concerning registration in civil engineering in the Engineering Record of Dec. 18, 1915, and found them very interesting. After being employed by a large structural company for nearly three years on a variety of design and construction, and having come into rather close contact with engineers and engineering departments of a number of large and small concerns, I offer the following replies to the questions asked:

1. The decline in registration of civil engineering students is, undoubtedly, due to the discouragements offered to those engaged in the profession. (a) A just return —that is, sufficient to enable an engineer to support a home as any professional man should, comes to very few. The complete statement of an employer of engineers, that it is an easy matter to get plenty of good, experienced structural engineers at $150 per month, is known to him to be as untrue as it is to the employed engineer to be a "bluff" to hold his salary down. It is unfortunately true that men can be hired for that amount, but they are too often merely engineers. (b) Engineers in general are little respected by field superintendents and non-technical practical men in general. This, I believe, comes about from the following causes: Superintendents are usually older, are better versed in practical methods and have keener judgments; they are among the better paid men, so are able to live without worrying whether prunes are 11 or 12 cents per pound, and their efficiency is therefore higher; the engineer, young because the older men will not assume the responsibility at the market salaries, is compelled to employ his leisure time, if he has any, in some immediately remunerative occupation, thereby reducing his efficiency and depriving him of the privilege of bettering himself as an engineer.

While in college I often listened to the advice, and I believe it sound, to young prospective engineers to overlook the small salary in the early years of practice and to put their maximum energy into the profession. This is clearly indicative of the high ideals of the advisors, but the fact cannot be sidestepped that a man must earn more than the average engineer now does before he can cease to think at almost every turn, "I would like to, but cannot afford it." The engineer must face the unfortunate high cost of living. A man with no taste for art, music or literature, no appreciation of the value of friends, and no idea of the relation of living well to efficiency—the one without the personality to make a real man—can live on his income, can save money, can even become an engineer—at the expense of his development as a member of society, as a real man. There are unfortunately plenty of these already in the field of engineering.

2. Instead of the question, "What is the remedy?" (for the decline), I would substitute "Will the decline be a remedy for the present conditions?" It will in that a smaller supply of engineers with an equal, or, from present indications in the business world, a greater demand for them will make the field more attractive. The decline in registration is accentuated by the large number of men, and capable men, leaving the field, so that it is already becoming difficult to obtain *good* engineers. The decline will be a remedy for the decline.

3. The principal reason for alarm to the business man is that he is not, in many cases, broad-minded enough to see one of the most important sources of his own profit. The engineer is, to him, not a source of profit, but a "necessary evil," employed merely because the project cannot be ac-

complished without him. His vision, narrowed by seeing only money, *money*, MONEY, causes him to think that the smaller the salaries of his force, the larger will be his profit. Nothing is more absurd. When the supply of engineers becomes sufficiently limited to cause their demands for a better living to be listened to, better men will be attracted to and remain in their field, and just as surely will the poor engineers be driven from the field. An increase in salary is just as sure to show up a weak man as it is to hold a good one. A small number of good men can accomplish more than the equivalent, from the salary standpoint, of cheaper men, and while the majority of employers seem unable to comprehend it, their organization would be far more efficient. The larger salaries will probably attract sufficient men to the colleges, along with the men who choose the profession because they love it, to change the slope of the registration curve from minus to plus, and at the same time will eliminate those unable to make good from the practical field. This will be a much better condition for both engineer and employer than to have the better men forced into other occupations to obtain sufficient remuneration. Higher salaries will surely increase efficiency by enabling the young engineer, especially, to use his spare time for the profession instead of being compelled to use it to earn a living at any sort of occupation.

The salvation of engineering, for the present, seems to lie with those who have an independent income, and with those who are in it because they love it.

CLYDE B. PYLE.

Wilkinsburg, Pa.

SIR: The Engineering Record asks "Why is registration in civil engineering decreasing?" and invites answers to its interrogatory. The writer believes he has a partial answer to the inquiry, but desires to preface it with the statement that what he shall say are matters of personal knowledge, and perhaps apply only to the locality with which he is familiar.

The usual cycle of operations, leading to the graduation of a young engineer are substantially as follows: Little Willie has completed his high-school education, and coming into the possession of some one of the "Best Books for Boys" reads a glowing account therein where some poor but honest young man, with only a tow string, a handful of shingle nails, a saw and a hatchet, designs and constructs a bridge over a yawning chasm that has, up to the time of his advent, defied the efforts of the most eminent engineers. Incidentally, of course, little Willie later marries the daughter of the mighty railroad magnate and lives in happiness and luxury forever thereafter.

Now little Willie probably could not, naturally, make a decent button for a smokehouse door, but with his youthful imagination fired by the compelling experience of the poor young man aforesaid, he tells Mamma that he wants to be a civil engineer, with big capital letters. Mamma, of course, knows that engineering is considered one of the learned professions and "so dignified, you know," and she intercedes with Dad. Now Dad, like the father of most of our young engineers is, if not rich, at least comfortably well to do, so little Willie is entered in some institution where engineering is taught.

During his college experience, in the few lucid periods intervening between the mad rush of intercollegiate football, baseball, rowing, Frat rushes, etc., he succeeds in storing, partly in his head and partly on his shirt cuffs, sufficient theoretical knowledge to enable him to pass his final examinations and be graduated as a full-fledged C. E.

When he returns home he is somewhat surprised to find that no brass band and throng of admiring friends meet him, and still more surprised, as the days go by, to find that the community in general is not tumbling over itself to secure his valuable services; consequently he loafs.

Dad at last wakes up to the fact that little Willie is much more ornamental than useful, and some fine morning takes him to task. "Say, young man," says he, "do you appreciate the fact that I spent a lot of good hard money to put you through college?" The young man admits the fact. "Then," says the old man, "get out and do something." The young man is forced to admit that no flaw can be found in his father's reasoning, but tells him that it is considered undignified and "unethical" for a professional man to solicit employment. Then the old man goes up in the air. "Ethics be d——d!" says he. "If it were unethical for me to get out and hustle to sell lard, pork, beans, codfish and lots of other things, where would you be? Get out, get into the game. Show what you are good for, if you are good for anything. Get a move on."

Little Willie goes out in search of employment, and comes back a sadder and wiser man. He finds the field fully filled, and work as he may, finds no employment. He reports to Dad, and he, being wise in the ways of the world and knowing that if he can sell pork cheaper than his competitors he gets the business, suggests to Willie that he cut the price. And here comes in one of the queer things about engineering. To the average person, the man who owns, or can borrow a transit, set it up and squint through it, is an engineer. Well, Willie goes out again and does cut the price and gets a provisional promise of employment, but when he appears to his prospective employer, to consummate the contract, he finds, much to his amazement, that some other young engineer has underbid him and secured the work.

He reports to Dad and that at once arouses the old man's commercial pugnacity. "So that's the game, is it?" says Dad. "Well, we'll show those cheap skates a trick with a hole in it. Get out and get the work. Don't make any difference what the price is. Do it for nothing, if necessary. Get the work and I'll make up any loss there is in it. Get into the game."

Well, Willie does go out and get the work, but to get it he does it for substantially nothing, with the result that he spoils the business for legitimate practitioners. Of course, his customers, as a rule, get just what they pay for, but as "a sucker is born every minute" the supply is equal to the demand.

Now this is not an overdrawn picture. Its counterpart can be found in nearly every community, and it proves to the writer, at least, that the profession is now overcrowded. As the late Harriman said, relative to a different subject, the community has too many "undigested" engineers.

When we find, as we do, in the locality in which the writer resides, that large employers of engineering skill are paying for it less per diem, or per year, than they pay for purely mechanical capacity, it furnishes conclusive evidence that the supply exceeds the demand.

ENGINEER.

Utica, N. Y.

SIR: In response to your invitation to readers of the Engineering Record to discuss the reasons for the evident decrease in registration in civil engineering courses, I would offer the following:

Every man who intelligently makes the choice of his life work is governed, to a large extent, by individual reasons peculiar to himself only. This, as well as the fact that one's judgment as to the cause of this decrease is apt to be governed unconsciously by his personal viewpoint, which in turn has largely been determined by his experiences in the profession, makes it difficult to observe all of the existing general causes. But may we not safely say that to other reasons which have been contributed to this fact might be added this, the desire on the part of the student to associate himself in after years with some movement, profession or business occupation which will be reasonably permanent in respect to duration of time and locality? No one with a college education, if he will only use it consistently, can afford to overlook the advantages to be enjoyed in becoming a part of a community, thereby gaining recognition and prestige through constant contact with the life of that community, whether it be public or private.

The salary or income to be derived from such an occupation does not have to be large to equal the majority of salaries derived from the profession in question. Look under the heading of Personal Notes in each issue of the Engineering Record and read of recent appointments made together with previous employments which these men have had. One of the most important facts always remains untold—previous and present salaries. If the truth were known, we would find, in too large a percentage of cases, that these salaries have fluctuated greatly; yet who can truthfully say that the ability or qualifications of these men have been in direct and constant conformity with their pay? Steadiness and dependability on the part of an individual is bound to receive a reward, and these qualities directed along almost any line of employment which has a future, coupled with the advantage of a limited diversity of activities enjoyed only by a permanent resident of a community, will offset a very tempting salary in an engineering position which, in too many cases, to-day is and to-morrow very likely will not be.

Somebody has said that one rises in his position in life as far as he deserves to go. That may be true in many cases, but the completion of a piece of work on which an engineer may have spent the best years of his life and there attained success many times leaves him in an uncomfortable position in this time of intense specialization in a profession which demands, in most cases, quite as much of physical as of mental strength.

J. L. HERBER.

Watertown, N. Y.

APPROXIMATELY $3,000,000 will be spent for road construction and maintenance during 1916 in Kings County, Washington, according to figures recently compiled by the board of county commissioners. Practically all of this sum will be expended on roads outside the limits of cities, it is reported.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Railroad's Car-Float Mixing-Plant Mounts Locomotive Crane

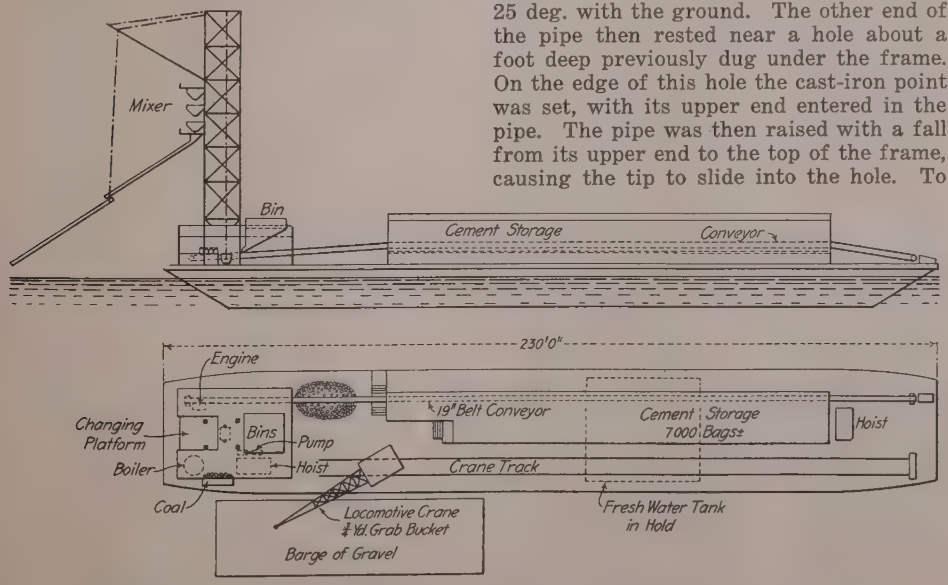
BY L. A. FRANCISCO
New York City

AN OLD Jersey Central car float has been converted into a well-designed floating concrete plant, which is now being used on pier construction for that railroad in New York harbor. The barge carries the concrete plant on its forward end, has a track on one side on which runs a locomotive crane which feeds the material bins, and carries a cement storage house with a capacity of 7000 bags through which runs a belt conveyor. In the hold under the cement house has been built a large tank for fresh water, which is delivered to the mixer by a pump under the material bins.

The car float is 230 x 36 ft. in plan, with its deck from four to five feet above the water. The cement shed has been made 112 ft. long and only 15 ft. wide, to save labor in handling the sacks from storage to the belt conveyor, which runs from end to end of the float and is used to fill the cement house as well as to convey sacks to the charging platform. The door of the cement shed is 4 ft. above the deck, and its roof 9 ft. above the floor. At the rear of the cement shed is a hoisting engine, which is used in moving the float. The crane track extends far enough beyond the cement shed so that the crane can swing in a complete circle.

The concrete plant, boiler, pump, conveyor engine, and tower hoist at the forward end of the boat are housed in a building 30 x 34 ft., built around the hoisting tower. The Haines gravity mixer is hung in front of the tower between two platforms, and discharges directly into the chutes. The concrete materials are drawn from the bins by gravity and measured in the hoisting skip. The mixer is suspended about 60 ft. above the deck, and the chutes, the first section of which is suspended from a boom, swing through an angle of 180 deg.

As will be seen from the accompanying drawing, the large space available on the float has been utilized so as to distribute the weight evenly, and yet to permit handling the concrete materials mechanically at a low cost.



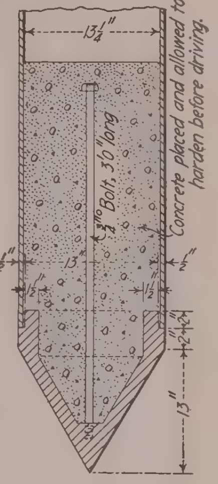
MECHANICAL HANDLING OF MATERIALS COMBINED WITH EVEN LOADING ON HULL

Standing Big Pipe Piles on End to Cast Tips

BY ALEX. P. CRARY
Ancon, Canal Zone

A LENGTH of 14-in. pipe had to be stood on end to cast each of the 3-ft. concrete plugs required to anchor the cast-iron tips to the 60-ft. pipe piles driven for the quarantine landing stage at Balboa, Canal Zone, described on page 801 of the Engineering Record for Dec. 25, 1915. As shown in the accompanying drawing, these tips were held on for driving by a bolt anchored in a concrete plug which also served to keep the piles dry inside until they could be filled with reinforced concrete after driving. Although only the first length of pipe was handled in concreting the points, the other two lengths being screwed on later, this lower section with its weighted tip made an unwieldy load. These sections were handled by hand, as there were only 56 piles required. The easiest method, apparently, was dropping the pipes down a convenient bank over the points, and raising them up from a low frame on top of the bank. This worked all right with the first batch till it came to lowering the piles to screw on the additional lengths of pipe. Then it was found that the weighted tips made the business of getting them back up the bank entirely too slow. The majority of the piles were therefore raised by a high frame. One end of each pipe was first set on a high horse so that it made an angle of about 25 deg. with the ground. The other end of the pipe then rested near a hole about a foot deep previously dug under the frame. On the edge of this hole the cast-iron point was set, with its upper end entered in the pipe. The pipe was then raised with a fall from its upper end to the top of the frame, causing the tip to slide into the hole. To keep the point from plowing through the far side of the hole, two snub lines from the lower end of the pipe to a near-by track were kept taut till the pile neared a vertical position. After the concrete deposited in the points had set, the pipes were lowered, the extra lengths screwed on and the piles were ready for driving.

It cost $1.60 per pile to place and concrete the points, and $3 per pile to screw on the two extra lengths. These costs, and those given in the previous article, might be considerably reduced on a second job under the same conditions, as the new methods developed made some experimenting necessary.



The writer was contractor for the work described, which was done under the direction of Rear Admiral H. H. Rousseau, engineer of terminal construction.

Handling Pipe Line Under 15-Lb. Pressure While Bridge Is Raised

BY R. C. HARDMAN
Colorado Springs, Colorado

AN EIGHT-INCH pipe line under 115-lb. pressure was recently suspended from a through-truss steel bridge successfully while one end of the latter was raised 5 ft. The highway bridge, which was 105 ft. long, and contained six panels, was raised by the writer. The water line came up out of the ground at either end with two 90-deg. bends and was laid across the bridge under the floor of a sidewalk and on top of the cross-girders. It was out of the question to disconnect the line and raise it with the bridge, as it was the only supply of quite a large population. The line, therefore, had to be raised and connected again in as small a time as possible. It was cut in advance of raising the bridge, brought up to its new level, and a 5-ft. length put in the vertical rise. It was not feasible to support the pipe line except from the bridge, which would be a constantly rising support, because of a swift current and the presence of more or less drift ice. Therefore, at four panel points of the upper chord a railroad tie was lashed so as to cantilever over the pipe. From the end of each tie was hung a set of falls which was connected to the pipe. The leading part of the line was then made fast to the lower end of the intermediate bridge posts. As the bridge was slowly raised, one man slacking off falls was able to keep the pipe close enough to grade to prevent springing open any of the calked joints.

Falls were placed at four of the panel points. At the fifth panel point where the total rise was only 0.83 ft., a block was placed under the pipe and slipped along on the bottom of the box in which the pipe rested as the bridge rose to meet the pipe. As the pipe was under very heavy pressure, and in crossing the bridge was several feet higher than in the trench, precautions had to be taken to prevent longitudinal movement. This was done by means of struts between the vertical section of the pipe at each end and the sides of the excavation. Even then the end pressure, about 5750 lb., forced one pipe far enough from its hub to cause a bad leak. The results on a whole were fairly satisfactory, considering that an 8-in. pipe under 115-lb. pressure suspended in the air for a distance of 110 ft. is a ticklish thing to handle.

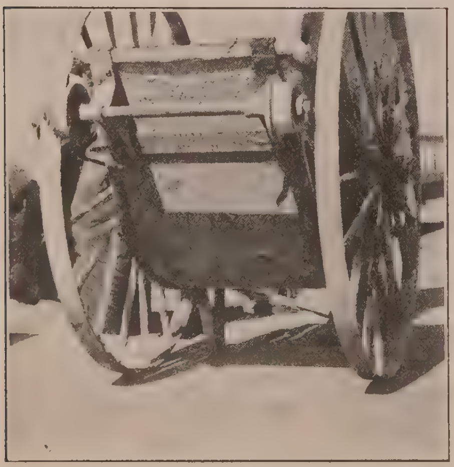
Traveling Elevator Dumps Buggies Into Form Above Runway

BY HOMER V. KNOUSE
Construction Engineer, Metropolitan Water District of Omaha

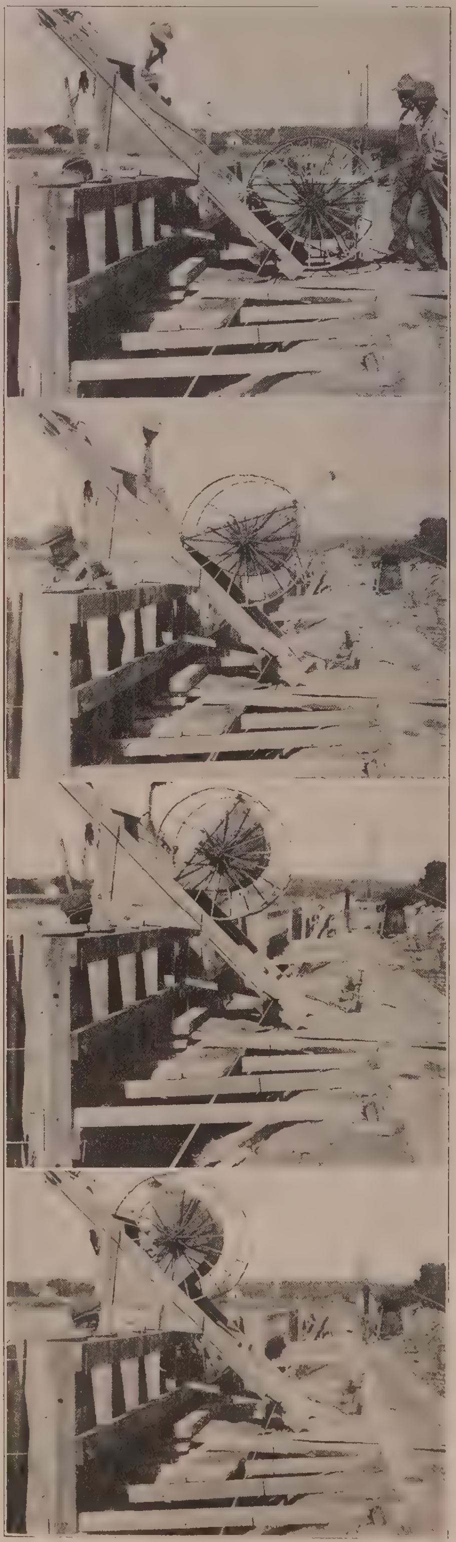
THE accompanying photographs illustrate a handy substitute for shoveling when the forms are a little higher than the runway used by the concrete wheelers. In building basin No. 6 at the Florence Station of the Metropolitan Water District of the city of Omaha it was found desirable to use for pouring the 9-ft. vertical wall section the same buggies that had been used in pouring the slopes of the basin. The top of this wall was 3 ft. above the top of the basin embankment, and without the elevator used it would have been necessary to dump the buggies onto platforms and shovel the concrete into the forms, or to build runways around the entire basin at the height of the top of the forms.

A small removable truck with two flanged wheels was attached to the front end of the buggy, and an eye-bolt placed slightly above and back of the axle through each side of the body. This auxiliary truck tracked on a pair of rails on the inclined runway of narrower gage than the channel track for the large wheels. These inner rails had a "drop-over" at the upper end for stopping and holding the nose of the buggy at the point where dumping should begin. Twin hooks attached to the hoisting cable were slipped into the eye-bolts in the side of the buggy, and by a suitable arrangement of sheaves the cable was led to a small single-drum steam hoist. Six buggies were equipped with the necessary studs and eyebolts, and the auxiliary truck attached to each turn as it was brought to the form. After dumping, the clutch on the hoist was released and the buggy returned to the bottom of the runway by its own weight. The attaching and removal of the hooks and truck required but a few seconds' time after the men had systematized their movements, and it was possible to dump from fifty to seventy loads per hour under these conditions. Considerably greater speed could have been obtained by providing each buggy with a truck, to be left in place while on this work. Owing to the steep slope of the bottom of the body when in the top position the load was very quickly dumped, and no scraping or hammering was necessary to get a clean discharge.

The satisfactory operation of this device has made it evident that by using longer rails and increasing the angle of inclination it may be used in pouring walls of considerably greater height. Its portability permits frequent moving to suit the progress of the pour, and on long walls it might advantageously take the place of a tower and chute installation. The device was designed by the writer and built in the shops of the water district.



EXTRA WHEELS ON BUGGY



HOW THE INCLINE WORKS

Can of Boiling Water in a Barrel Thaws Dynamite

BY PACKING the sticks around a 10-gal. oil can filled with boiling water and placed in an old barrel, and filling the barrel full of empty sacks to retain the heat, 50 lb. of dynamite may be safely thawed at a time. The barrel used should have one or two ½-in. auger holes in the bottom, which should be covered with two or three inches of straw, hay, sawdust or anything that will allow water to filter through easily. This precaution is necessary to let any water that might be spilled drain out. In filling the can with boiling water it is a good plan to leave an air space of about 2 in. at the top. If the weather is not very cold, it is best to wrap the can of hot water in a sack to prevent the dynamite from coming in direct contact with the heated metal. The cartridges should be placed loosely around the can, so as to leave plenty of space for the hot air to circulate about them. In rainy weather the barrel should, of course, be covered to keep the water out, and if a strong wind is blowing it should be placed in a sheltered place. In very cold weather it is best to sink the barrel in the ground. As it takes a temperature of 356 deg. Fahr. to explode pure nitroglycerine, there is no danger of accidents in using this arrangement. Tests have shown that the highest temperature in the barrel will not exceed 80 deg.

This method of thawing dynamite is described by J. H. Carse in the *DuPont Magazine*, and has been used by him for some time.

Cotton Rope in Groove Makes Sheet Piling Watertight

BY N. G. NEAR
New York City

SMALL cotton ropes threaded into the grooves of the steel sheet piles were used recently with success to make three cofferdams watertight by A. J. Twiggs & Son, contractors, of Augusta, Ga. The piling, 16 ft. in length, was under a head of 12 ft. at the bottom, where it was driven into shale. It was necessary for all three of the cofferdams to be practically watertight. This, the contractors state, was accomplished by the cotton swelling under water and cutting off the flow. No trouble was experienced in pulling the piles. The rope was laid in the interlock at the time the piles were threaded.

A THREE-MILE TUNNEL IN ASIATIC TURKEY, piercing the Amanus Mountains on the the border between Asia Minor and Syria, on the line of the Bagdad Railroad now under construction, has just been completed, states a recent consular report. The bore is known as the Baghtché tunnel; it is about 75 miles east of Adana and 60 miles northwest of Aleppo. The exact length of the tunnel is 16,028 ft. It has a summit in the middle 246 ft. higher than the lower portal.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

General Wood Addresses Yale Engineering Society

Reserve Corps of Engineers' and Contractors' Men Would Be Useful Even Without Military Training

Pointing out the Boston defenses as an example, and calling attention to the great usefulness of engineer reserve corps, even without military training, and the value to the army of men with construction experience, Major General Leonard Wood addressed a stirring talk to the annual meeting of the Yale Engineering Association, held on the evening of Dec. 29 at the Yale Club in New York City. Following this address, N. C. Kingsbury, vice-president of the American Telephone & Telegraph Company, described with the aid of motion pictures the building of the transcontinental telephone line, and its relation to preparedness. The guests then talked over this line with other gatherings of Yale men in Chicago and San Francisco. The association, whose membership has increased 20 per cent to more than 600 since its first meeting in New Haven a short time ago, then proceeded with the annual election of officers, the president, Edwin M. Herr, and secretary, Richard T. Dana, being re-elected.

Report Made on Division Street Bridge Failure in Spokane

The Division Street bridge in Spokane, Wash., failed on Dec. 18, dropping a street car into the river, killing five passengers and injuring twelve. The failure has been investigated by a board of four engineers appointed by Morton Macartney, city engineer. The unanimous report, made after an examination of the lower chord eyebars in the end panels and of the wrecked structure lying partly in the water and partly on the bank, says in part:

"The failure was due to the simultaneous breaking of the bottom chord bars of the first panel of the north end of the east truss because of granulation. There was no excessive load on the bridge at the time it collapsed. We noticed breaks in the steelwork other than those above mentioned, caused by the falling of the bridge, and these show silky fractures, indicating first-class material, and we are of the opinion that, had the structure been examined by experts the day before its failure, they would have reported the same entirely safe for the duty it was fulfilling, and that there was no reason to expect defects of any character."

This report was signed by the four engineers: S. H. Hedges, president of the Puget Sound Bridge Company; Bertram D. Dean, consulting engineer, of Seattle; Frank M. Cortelyou, resident engineer of Columbia Interstate Bridge, and F. W. Crocker, engineer of the Pacific Bridge Company.

Hugh L. Cooper of New York City was the designer of the bridge, which was built in 1892 and fabricated by the Edgemoor Bridge Company. It was a through sub-divided Pratt truss bridge, 180 ft. long, of ten 18-ft. panels, with a 40-ft. roadway and two sidewalks. Mr. Cooper, who happened to be in Spokane at the time of the catastrophe, stated to a representative of the Engineering Record that the failure was probably caused by the fact that the broken 5 x 1½-in. eyebars had been injured in 1894, when struck by the flood wreckage from a collapsed Howe-truss railroad bridge, and had been removed, heated and straightened without subsequent annealing. He says the bars showed every evidence of sudden failure without elongation, which would explain the crystalline appearance. The unit stress in the bars at the time of failure was probably only about 7800 lb. per square inch.

Mr. Cooper understands that the authorities at Spokane consider the above as a preliminary report and that a full technical and scientific investigation is to be made in order to determine the exact cause of the failure.

Center Headings Meet at Rogers Pass Tunnel

With no noticeable variation in grade and line the center headings of the Canadian Pacific Railway tunnel under Rogers Pass at Glacier, British Columbia, met Dec. 19. Two women, the wives of J. G. Sullivan, chief engineer of the Canadian Pacific, and A. C. Dennis, general superintendent for the contractors, Foley Bros., Welch & Stewart, were with the railway officials in the heading when the final blast was fired, and were the first to step through the newly-opened passage.

Three and one half miles of the center heading have been completed during the past year, progress on this tunnel having broken all American records. A summary of recent rapid driving done at this tunnel will be found on page 209 of the Engineering Record for Aug. 14, 1915, and a description of the work and methods used was published on page 604 of the Dec. 5, 1914, issue of this journal.

Part of Memphis Bridge Falsework Carried Out

About midnight on Thursday, Dec. 23, a flood stage of 30 ft. in the Mississippi River carried out the falsework between piers 3 and 4 of the new Harahan cantilever bridge at Memphis, Tenn., taking with it some of the lower chord members and floor stringers. Fortunately, the adjacent 621-ft. fixed span was completed and swung two days previously, and from last reports the falsework for this span, upon which it still rests at some points, was still intact.

Urge Licensing of Engineers in Pennsylvania

The state engineer's commission is expected to make a report to Gov. Martin G. Brumbaugh within a few days on the question of licensing engineers engaged in the construction or operation of public or private hazardous works. F. Herbert Snow, chief engineer of the State Public Service, heads the commission, the other members being: Dr. John Price Jackson, head of the State Department of Labor & Industry; George S. Webster, director of the Department of Wharves, Docks & Ferries, Philadelphia; Samuel A. Taylor, consulting engineer of Pittsburgh, and J. Murray Africa, city engineer of Huntingdon. It is thought that the licensing of engineers will be urged in the report.

Concrete Institute to Hold Convention Feb. 14-17

In order that the members present may have an opportunity to attend the Cement Show, the annual convention of the American Concrete Institute, at Chicago, will be held Feb. 14-17. The sessions will be held in the morning and evening, and it is expected that joint sessions with other organizations will be arranged for some of the afternoons. The annual banquet will be held on the evening of Feb. 16.

New Refuse Disposal Contracts for New York City

Commissioner John T. Fetherston Prepares Alternative Forms of Proposal—Law Limits Term to Five Years

With existing contracts for the disposal of garbage, ashes and rubbish due to expire Jan. 1, 1917, the city of New York, through John T. Fetherston, commissioner of the Department of Street Cleaning, has prepared new alternative forms of proposal on which bids will be received until Jan. 18. One of the proposed forms of contract specifies a private plant on private land, while the other provides for a site on city land, the installation to be purchased by the city at the end of five years.

New York City is restricted to contracts for a 5-year term for the final disposition of various classes of refuse. Although the existing disposal contracts expire next year, the city has the privilege of renewing them for a further period of two years. For the purpose of determining the advisability of such renewal the new contracts are being advertised.

Contract form 1 provides for the disposal of garbage at private plants located on private lands for a period of 5 years. The feature of this contract requires the contractor to pay the city an amount per annum for the privilege of disposing of the garbage. The total amount of garbage delivered in 1914 was 412,200 cartloads of 2 cu. yd. capacity, and weighing approximately 2330 pounds per cartload. Plans and specifications showing the general outline of plant and methods of treatment proposed for use by the contractor are to accompany the bid. Stringent provisions cover design of plant and equipment so as to obviate nuisance due to the escape of odorous gases or other obnoxious wastes.

City Will Purchase Plant

Contract form 2 differs from the preceding contract in that the plant will be erected on a site provided by the city. The contract term is limited by law to a period of 5 years, and the city agrees to purchase the plant on the termination of the contract at a price to be fixed in the bid or estimate by the contractor. The contract likewise requires the bidders to submit general plans and a guaranteed maximum estimated cost for the construction of the plant and appurtenances. The methods proposed to be used and the design of apparatus are subject to approval by the commissioner of street cleaning, and definite guarantees covering nuisances and odors are required, as in contract form 1.

Under the conditions noted in form 1 the contractor would naturally amortize his plant during the 5-year term of contract, while in form 2 the contractor finances the undertaking and is required to make any profits out of the operation of the plant during the term of the contract, as the plant is to be built at actual cost under the supervision of the city.

On account of the difficulty of securing city funds for the construction of a municipal plant at the present time, the authorities decided to attempt to interest private capital in financing the undertaking under form 2. As there is but a slight risk in the investment on account of the city's agreement to purchase the plant it would seem as if this would be the more attractive proposal to contractors.

Last year Commissioner Fetherston attempted to secure legislation which would enable the city to make a 15-year profit-sharing contract for the disposal of all classes of wastes, and the bill passed both houses of the State Legislature, but was vetoed by the Governor. Thus the city has available only two means of disposing of its waste: First, by contract for a period not to exceed 5 years; and, second, by municipal construction and operation of the disposal works.

Indiana Commission Fixes Value of Terre Haute Waterworks

A rate of return not to exceed 6½ per cent on a seemingly rather liberal valuation is allowed the Terre Haute Waterworks Company in a decision just handed down by the Public Service Commission of Indiana. The Commercial Club of that city had sought to have the water rates reduced, and the petition was granted in part by a reduction in the metered-service rate of from 30 to 20 cents per 1000 gal. for the first 20,000 gal. consumed in any one month. On an estimated valuation of $1,200,000 the commission finds that the company should be allowed to earn operating expenses of $60,000 annually, taxes of $22,000, depreciation of $10,000 and a profit of $78,000. The commission holds that, because much of the value of the plant has been built up in past years from surplus earnings, the rate of return now allowed should not exceed 6½ per cent.

In making up the valuation of $1,200,000 the commission fixed the reasonable cost of reproduction new of the distribution system at about $640,000, and the present value at $590,000. A greater allowance for labor than that figured by the commission's engineers was granted, owing to the treacherous soil conditions in Terre Haute, and the tendency of trenches to cave in. On the other hand, although the commission's staff allowed $106,910 for paving over mains, the commission cut this down to $8,000, which covers only paving actually done by the company.

For the pumping station and equipment, which the commission called antiquated, there is allowed a present value of $145,000, based on a reproduction cost of $200,000. Other buildings, fixtures and grounds were depreciated from a reproduction cost new of $120,000 to a present value of $100,000. The allowance of the commission's staff of $18,400 for land the commission increased to $25,000, this including $1,000 for a certain easement.

Going value was placed at $80,000, as compared with $239,948 claimed by the company. For working capital $22,500 was allowed. Thirteen per cent of the total valuation was allowed for contingencies.

Not much was said as to the basis for the seemingly small allowance of $10,000 annually for depreciation. The Engineering Record has no information as to the original cost of the property. The total reproduction cost new, exclusive of going value, was fixed at $1,259,845, which was depreciated about 12 per cent, to $1,106,335. After the going value of $80,000 was added the sum was rounded out to an even $1,200,000.

Want Government Nitrate Plant

The establishment of a government nitrate plant to make nitric acid as a defense precaution was recommended by the Naval Advisory Board in a report sent to Secretary Daniels, Dec. 22. Brig.-Gen. William M. Crozier, chief of ordnance of the U. S. Army, also recommends the establishment of such a plant in his annual report.

The plan is that the government shall make use of some water power in the interior, in a spot inaccessible to an invading enemy, and make the acid by extracting nitrogen from the air by electrical processes.

U. S. Chamber of Commerce to Hold Annual Meeting

The fourth annual meeting of the Chamber of Commerce of the United States will be held at the New Willard Hotel, Washington, D. C., Feb. 8-10.

Members of Chicago Traction Commission Selected

The subcommittee, of which Henry B. Capitain is the chairman, has begun the work of selecting the three members of the Chicago Traction Commission who can be recommended to the local transportation committee and later be confirmed by the Chicago City Council. Bion J. Arnold has tentatively been selected as the Chicago member of this commission, and William Barclay Parsons of New York has been tentatively selected as the second member. The committee is considering a third member, whose qualifications will make him especially fitted to round out a commission made up of the two members who have been tentatively decided upon. The subcommittee is making a strenuous effort to decide on the three members, so that it can report to the local transportation committee and obtain the approval of the Chicago City Council. This would permit actual investigation of Chicago transportation problems to begin early this month.

Changes Contemplated in Indianapolis Building Code

R. F. Dagget and Herbert Foltz, appointed by the Architects' Association of Indianapolis, are working in co-operation with Jacob H. Hilkens, city building inspector, in drafting possible changes in the city's building code. Similar committees are to be appointed from the builders and the material supply men. Mr. Hilkens is advocating the restriction of stairways in public buildings to non-combustible materials. Wooden floors in motion picture houses also may be forbidden.

Montana Expects Repetition of Success in Forestry Short Course

The University of Montana, Missoula, has had unusual success with its short course for forest rangers, and has now announced the course for the year 1916, which will begin Jan. 4 and close April 8. The course includes surveying and mapping, scaling and cruising, fire protection, forest improvement, forest administration, lumbering, botany and silviculture, and grazing and seminar. Various electives are also available. The course will be given by the regular faculty of the Forest School, aided by special lecturers. The principal courses will be under the direction of Dorr Skeels, dean of the Forest School, James H. Bonner, professor of forest engineering, W. M. Drake, professor of forestry, and T. C. Spaulding, professor of forest utilization.

It is expected that the coming session will be the most popular in the seven years' history of the short course. Last year students were attracted from every state west of the Mississippi that contained a national forest. This year it is expected, on account of the unavailability of the German forestry schools, there will be students from other countries. Already word has been received that the forester of New South Wales will attend and at least two men are expected from Canada. In the regular four year course there are students representing half the states of the Union.

Pan-American Scientific Congress Opens in Washington

The Pan-American Scientific Congress opened in Washington Dec. 27, with several hundred engineers, scientists, educators, lawyers, bankers, physicians and railroad men from the United States and the Latin-American countries in attendance. The formal opening took place in Memorial Continental Hall, the national headquarters of the Daughters of the American Revolution.

Short Highway Course at Michigan

The University of Michigan will hold a short course in highway engineering, Feb. 21-25.

Material Men Cannot Recover on Contractor's Bond in New Jersey

The Standard Gas Power Corporation of New York has lost its suit to recover from a $20,000 performance-of-contract bond, written by the Maryland Casualty Company in favor of the Passaic Valley Sewer Commission for the Healy Contracting Company, the sum of $3,862.25. The amount was for materials furnished the contracting company shortly before it became bankrupt in attempting to execute a contract for a section of the Passaic sewer under the streets of Newark. The Casualty Company was defendant in the action. The case was tried without a jury by Judge William H. Speer of the Supreme Court of New Jersey. The Court said in part: "It must be manifest that in each case the question is, what is the intention of the parties to the contract? The courts of several of the states, whose decisions are cited in the brief of the plaintiff's counsel, have laid hold of the absence of mechanics' liens or other protection furnished to a material man or laborer in those jurisdictions, and of language of a more or less general and ambiguous character as facts tending to demonstrate that the parties, in entering into the contract, must have entertained the intention of extending the benefits of this contract to third parties, so as to enable them to sue thereon.

"In this case there exist no such facts nor evidence of any such intention, but, on the contrary, it seems perfectly clear that this was a mere contract of indemnity running solely to the Passaic Valley Sewer Commissioners and was not intended to create any obligation in favor of laborers and material men, and I so hold."

$2,000 Spent by New Society Saves $3,000 to Profession

More than 100 engineers put in touch with positions, at no cost to the engineer or employer, thereby saving them about $3,000, all at a total cost of less than $2,000, is the gist of the report of the activities of the service clearing house of the American Association of Engineers, presented by the secretary at the first annual convention held in Chicago, Dec. 10 and 11. The $2,000 represents all the moneys spent since this organization, devoted to the welfare of the engineer, started its existence 7 months ago. The work of the clearing house has practically all been done since Sept. 15.

In one-half of the applications filed, reported the secretary, there is a steady decrease in the average pay of the engineer from $150 in 1910 to $110 now, a fact that he felt ought to be given serious consideration. While dishonest and incompetent employment agencies are not nearly as prevalent as commonly believed, still instances were given of exorbitant fees charged for positions held only a few days.

The organization has now about 300 members and received 40 additional applications at the Saturday afternoon meeting, which was attended by 400 engineers, 200 of whom were visitors.

In an address by J. H. Prior, chief engineer of the Illinois Public Utilities Commission, on "The Economic Aspects of Engineering Pay," he demonstrated by diagrams that the pay of the lowest "marginal" man in an organization had a direct effect on that of the highest paid. He also pictured the law of supply and demand, showing that the same result was obtained in case free bargaining was indulged in and full knowledge of conditions was known by both the engineer and his prospective employer.

Prof. F. H. Newell outlined the problems of the engineer from the welfare standpoint. He emphasized the idea that this organization is in no wise antagonizing any other good movement, but will stimulate and help the existing organizations far more than it will draw from their membership. He spoke at length on the duty of the society to the engineer and suggested that younger men be chosen more often as officers.

Capt. Horace B. Wild, aviator, gave an illustrated address on the advances in aviation with special reference to the recent improvements made in Europe. He predicted New York to San Francisco passenger service similar to that maintained in Germany before the war started and showed a cross-section of an airship by which it could be attained.

Bond of Irrigation Company Forfeited for Not Completing Works

The $25,000 bond of the Rio Mimbres Irrigation Company of Luna County, New Mexico, was forfeited to the state, during the week ending Dec. 18, the federal court holding that the company had failed to build any of the projected dams or reservoirs on lands purchased from the state, and had also lost its rights under the contracts entered into with the state. The decision was made after hearing the suit of the company against R. P. Ervien, state land commissioner.

The court ordered an examination of the land by State Engineer French to determine just what portion of it should be left under control of the company, the court holding that the company had the right to dispose of such lands to investors as it was prepared to furnish with water.

The examinations ordered, which will cover the wells put down by the company, are now in progress and the final decree will be entered this month. The company claims to be able to irrigate from 5000 to 7000 acres with water pumped from 28 wells. Several other wells have been put down and are classed as probable producers of water for irrigation.

According to a statement made on the witness stand by L. G. Fisher, Jr., of Chicago, vice-president of the company, the concern has spent approximately $325,000 in its efforts to develop an extensive water supply in Luna County. The suit was brought by the company following the refusal of Commissioner Ervien to issue a deed to a 40-acre tract of land upon its application. In the trial of the case the company admitted that it had failed to build dams and reservoirs, but sought to explain this on the ground that it was impossible to develop water for irrigation by such means.

White River Levee Improvement Almost Completed

Work on the White River levee improvement, which is expected to prevent a recurrence of such flood disasters as were sustained by Indianapolis in 1913, will probably be completed within the next three months. The cost will total in the neighborhood of $1,200,000. The city administration is at present planning methods of making the final payments.

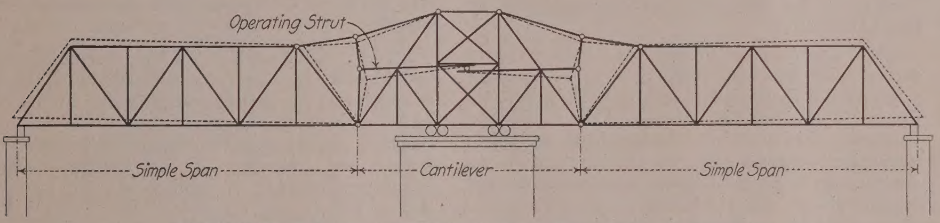
Wire-Drag Has Revolutionized Hydrographic Surveying

The use of the wire-drag has revolutionized hydrographic surveying, according to the annual report of the superintendent of the U. S. Coast and Geodetic Survey. Soundings with leadline have not proved by any means infallible, and submerged rocks and ledges were often missed with consequent damages to shipping. With the development of the wire-drag hydrography, these submerged dangers have been discovered and chartered. During the past year four wire-drag parties were in the field, and the results proved the wisdom of doing the work on the larger scale.

Strauss Cantilever Swing Bridge Lays Claim to Economy

During the past fifteen or twenty years improvement in movable bridges has been confined largely to the very great advances in bascule design. More recently the vertical lift type has also undergone extensive development. The swing bridge or horizontal draw type, however, has received comparatively little attention. J. B. Strauss, consulting engineer, Chicago, whose last contributions to bridge engineering was the counterbalanced lever lift bridge, has now developed a swing bridge which lays claim to much originality.

This design, known as the Strauss cantilever swing bridge, departs radically from all existing types, while at the same time having no elements which are unknown and untried. Its characteristic features are: First, the use of direct driven trucks running upon ordinary railroad rails to effect rotation; and second, the construction of the central portion of the draw span as a cantilever projecting beyond the center pier with the arms pin-connected at their ends to as to constitute simple spans from the ends of the cantilever to the abutments.



NEW DRAW SPAN OF CANTILEVER TYPE LIFTS BY TOGGLE METHOD

End Lifting and Turning Mechanism

The top chord of each arm is connected to the top chord of the central draw portion by a two-panel link, which is in turn connected to a pivoted vertical. The pivot point of that vertical connects with an operating strut and a driving motor on the central draw portion, so that when the strut is drawn backward, the four linked elements on each side of the center act as a double toggle, raising the end of each arm off its bearings on the abutment until the span is free to turn.

The turning mechanism comprises a series of trucks, mounted under the central draw at four points, the intersections of the four verticals of the central span with the chords. Each truck is swiveled about a vertical axis through the truss post and travels on rails on the pier. For large bridges the number of wheels on each truck is eight, traveling on four concentric rails. For very large bridges, the number of wheels per truck may be increased still further without altering the principle of equal distribution of load upon each wheel. For smaller bridges, four- and two-wheel trucks are sufficient.

Live Load Wedges

Associated with each truck is a wedge located directly under its center and which, when the bridge is in its closed position, engages with a wedge seat on the pier. This wedge is automatically operated by the raising of the arms already referred to. When these arms are lowered into position, the wedges are driven home and the live load of the bridge is then taken off the trucks and directly transmitted to the piers. When the arms are lifted, as already described, the wedges are automatically withdrawn and the bridge is then free to move with the trucks.

The operating machinery proper comprises driving mechanism on the trucks, or on the connecting bracing, and imparting motion to the wheels directly by means of the customary gear train driven by a street-car type of motor or other prime mover. Braking is effected either through the gearing or directly on the rails.

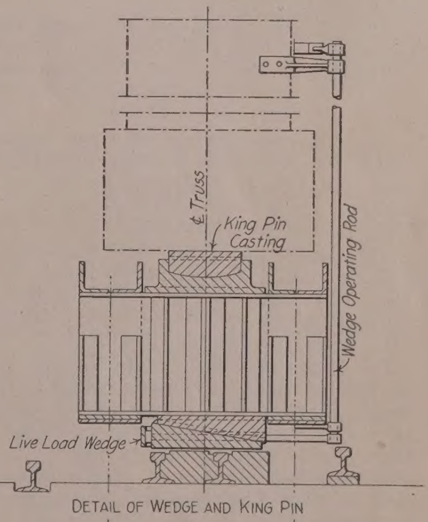
Economy and Advantages Claimed

The economy of the design as compared with other swing bridges is claimed to be pronounced. The trucks replace the drum, roller and tread of one type of swing or the corresponding center bearing and trailer wheels of the other, effecting a very material saving both in steel and cost of fabrication, the direct drive replaces the costly circular rack used in all types, while the cantilever and simple span construction of the trusses in place of the continuous girders, reduces the weight per foot as well as the total loads. Furthermore, the elimination of the spider and end lifts, the lesser weight to move and the greater simplicity of the bridge as a whole make the cost of its operation and maintenance less than that of other types of corresponding size and capacity.

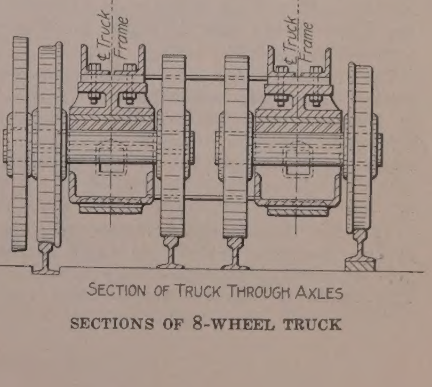
In addition to its economy in first cost and upkeep, the design possesses other important advantages as follows: The elimination of the drum reduces the required distance from floor to top of center pier and makes it possible to place the floor close to the water line. For the same reason the difficult problem of equal distribution of the load upon the track is thus solved. The lifting of the arms from the central draw portion does away with both the rail and end lifts and accomplishes with one device what is now done by two. The double-toggle system used also overcomes the objections to other devices which have from time to time been proposed for this purpose.

The independence of the two arms from the central draw portion does away with the indeterminacy and uncertainty of stress and converts the bridge into a definite, positive structure throughout. There is, further, no uplift at the ends and the reactions are exactly computable.

The design is patented by J. B. Strauss, president of the Strauss Bascule Bridge Company, consulting engineers, Chicago.



DETAIL OF WEDGE AND KING PIN



SECTION OF TRUCK THROUGH AXLES

SECTIONS OF 8-WHEEL TRUCK

Falsework in Chattanooga Bridge Washed Out

On Monday morning, Dec. 19, the falsework for span 3 of the Market Street bridge in Chattanooga, Tenn., now under construction over the Tennessee River, was washed out by the 28-ft. stage flood just the day before concreting was to begin. The reinforcing steel was in place, so that unless there is some salvage from the timber and steel now in the river the loss will be about $40,000, according to early reports, or at least $20,000 as stated later.

This span is the third reinforced-concrete arch from the Chattanooga shore on the south, and is 180 ft. long. The falsework under span 2 is still in place, but the concrete has been poured and it is not expected that any further damage will be done to this part of the bridge. The cofferdam for pier 4, which is to carry one end of the bascule span, was also washed out, and much of the plant is reported lost. This is the third time the cofferdam has been washed out by floods. The construction work is being done by the Vang Construction Company of Cumberland, Md., and the bridge is being built for Hamilton County under the direction of the Tennessee River Bridge Commission.

Illinois Central Presents Locomotive to University of Illinois

The Illinois Central Railroad has presented a 150-ton freight locomotive to the University of Illinois. It will be used for experimental purposes in the Department of Locomotive Engineerings.

News of Engineering Societies

The Association of Engineering Societies of St. Louis officially disbanded Dec. 31, 1915.

The New England Waterworks Association will hold its annual meeting at the Hotel Brunswick, Boston, Jan. 12.

The Michigan Chicago-Detroit Highway Association has been organized at Battle Creek to promote the movement to build a permanent paved road across the State to link Detroit with Chicago.

The Illinois Association of County Superintendents of Highways will hold its annual convention at Urbana, Jan. 10-12, during the time of the short course in highway engineering at the University of Illinois.

The American Society of Civil Engineers will hold a meeting at the Society House, New York City, Jan. 5. William P. Creager will present a paper on "The Economical Top Width of Non-Overflow Dams."

The Cornell Society of Civil Engineers will hold its annual banquet at the Hotel Breslin, New York City, Jan. 21. Clyde Potts, consulting engineer, 30 Church Street, New York City, is chairman of the committee.

The Engineers' Society of Western Pennsylvania will hold its annual meeting in Pittsburgh, Jan. 18. The subject of the presidential address by A. Stucki will be "Some Details Often Neglected by Engineers."

The Manitoba Branch of the Canadian Society of Civil Engineers will hold a meeting at Winnipeg, Jan. 6. W. G. Chace and D. L. McLean will present a paper on "Studies for, and Experiments with, Mixtures for Winnipeg Concrete Aqueduct."

The Illinois Section of the American Waterworks Association will meet at Urbana, Ill., in joint session with the Illinois Society of Engineers and Surveyors Jan. 26 and 27. The former organization will meet by itself on Jan. 25 and the latter on Jan. 28. Paul Hansen, Urbana, Ill., will have charge of exhibits.

The San Francisco Association of Members of the American Society of Civil Engineers held its annual meeting in that city on Dec. 17. The following officers were elected for the ensuing year: President, H. L. Haehl; vice-president, Jerome Newman. Mr. Haehl presented a paper on "Water-Right Litigation in the Santa Clara Valley."

The Philadelphia Association of Members of the American Society of Civil Engineers will hear George Gibbs, consulting electrical engineer of the Pennsylvania Railroad, speak on "The Electrification of the Pennsylvania Railroad from Philadelphia to Paoli" at a meeting to be held at the Engineers' Club in that city Jan. 3.

The Engineers' Club of St. Louis, which constituted about 72 per cent. of the membership of the recently disbanded Association of Engineering Societies, will begin the publication of a bi-monthly journal to be known as the "Journal of the Engineers' Club of St. Louis." Its board of editors will include civil, mechanical and electrical engineers.

The Engineers Division of the Chicago Association of Commerce has re-elected Edmund T. Perkins, consulting engineer, as its chairman for 1916. Harold Almert was made vice-chairman. R. M. Shankland, Arthur Maldaner and Robert I. Randolph were elected as additional members of the division to represent it in the ways and means committee of the association.

The Engineers' Society of Pennsylvania elected the following officers for the ensuing year, at the December meeting, held in Harrisburg: President, R. Boone Abbot, division engineer, Philadelphia & Reading Railway; first vice-president, W. W. Davis, district superintendent, Semet-Solvay Company; second vice-president, Morris Knowles, consulting engineer; directors, Frank A. Robbins, Jr., D. E. Tracy and Elton D. Walker; treasurer, John O'Connell; secretary, Edward R. Dasher.

The Engineers and Architects Association of Southern California made a trip by special Pacific Electric train from Los Angeles on Dec. 18 to visit points of engineering interest at Long Beach. The recently completed sewage screening and sludge-burning plant at that city was inspected, after which the party was shown the submarines under consideration at the Craig Ship Building Works, and then a launch took the party, numbering about 60, for an inspection of the harbor works.

Personal Notes

G. B. Shipley, consulting engineer, of Pittsburgh, has been retained to design a creosoting plant for the Boston Elevated Railroad to be used for treating ties and other material for that company.

O. W. Connet, for the past ten years division engineer for the Baltimore Sewerage Commission, has completed the work under his charge and has left the city's service. Previous to becoming connected with the sewerage commission, Mr. Connet had been employed on the engineering forces of Baltimore for about ten years.

F. J. Maran, assistant engineer for the Great Northern Railway, has been transferred for the winter from the field forces in North Dakota to the general offices at St. Paul.

Frank McLaughlin, formerly superintendent for James Stewart & Company, Inc., Contractors, of New York City, on the construction of the new plant for the Remington Arms & Ammunition Company at Bridgeport, Conn., is now engaged in a similar capacity on the construction of the new buildings for the Remington company at Ilion, N. Y.

E. B. Newell has left the service of the U. S. Engineer's Office, with which he has been connected 4½ years, on survey work and construction at Louisville, Ky., and is now located at Santa Barbara, Cal.

Gustav J. Requardt, acting division engineer of the sewage disposal plant for the Baltimore Sewerage Commission, has resigned from the city's service, upon the completion of that commission's work, and will probably engage in private practice as civil and sanitary engineer. He was six years with the sewerage commission on design and construction.

Ralph D. Wichmann is preparing plans and specifications for a new sub-station and an extension to the steam plant for the Mount Whitney Power & Electric Company at Visalia, Cal. Later he will probably have charge of the construction of the work.

Chauncey A. Burnette and S. H. Hedges have been retained by Morton Macartney, city engineer, of Spokane, Wash., to advise with him on the repairs to the Division Street bridge, the collapse of which is noted elsewhere in this issue. Mr. Burnette is consulting engineer and local representative of the Illinois Steel Bridge Company at Spokane and Mr. Hedges is president of the Puget Sound Bridge & Dredging Company of Seattle.

Leland B. Raab has been appointed city engineer of Tracy, Cal., succeeding J. H. Smith.

F. E. Kurzenknabe, formerly connected with the Louisville & Nashville Railroad as designer of reinforced-concrete structures and resident engineer in charge of the new terminal at Lexington, Ky., has become engineer and manager of the Congleton Construction Company of Lexington. Mr. Kurzenknabe was in the service of the Louisville & Nashville for about four years, one as designer of reinforced-concrete structures, and three as resident engineer of the Lexington work. In the latter capacity he had charge of the construction of two large reinforced-concrete viaducts and a 400-ft. concrete conduit to carry the waters of a creek, the grading for a large railroad yard and the building of a roundhouse, freight house and other terminal structures, as well as sewers, water mains and drainage lines. The Congleton Company will handle all kinds of concrete construction, and furnish designs and engineering service where required.

C. N. Beckner, formerly assistant signal engineer of the Louisville & Nashville Railroad at Louisville, Ky., has been appointed superintendent of construction in western territory for the Federal Signal Company. His headquarters are at Chicago.

Edwin H. Marks has been promoted to the rank of captain in the Corps of Engineers, U. S. A.

G. E. Norris, formerly superintendent of the Maryland & Pennsylvania Railroad, has been appointed chief engineer of the Virginian Railway with headquarters at Norfolk.

Charles O. Lenz, engineer, of New York City, has moved his office to the Equitable Building, 120 Broadway.

George F. Maitland, formerly division engineer for the Union Pacific Railroad at Cheyenne, Wyo., has been appointed division engineer of the Kansas division for the same company at Kansas City, Mo.

K. B. Duncan has been appointed valuation Engineer of the eastern lines of the Atchison, Topeka & Santa Fé Railway.

W. B. Goentner, formerly assistant engineer for the Department of Water Supply, Gas & Electricity, New York City, has been appointed superintendent of the factory of the McCabe Chemical Company at Charlotte, N. C.

Thomas H. Mather has resigned from the office of commissioner of public works of the city of Syracuse, N. Y.

F. A. Bonz, formerly assistant engineer for the Buffalo, Rochester & Pittsburgh Railway, has been appointed division engineer for the same road at Rochester.

G. J. Adamson, formerly special engineer of construction for the Union Pacific Railroad at Omaha, Neb., has been appointed division engineer of the Wyoming division with office at Cheyenne.

Henry Welles Durham, consulting engineer, of New York City, has been appointed county engineer of Bergen County, N. J. The duties of his new position will not take all of his time, and he will continue his consulting practice.

O. S. Beyer, Jr., formerly connected with the Rock Island Lines, has been appointed first assistant in the Engineering Experiment Station of the University of Illinois.

Paul E. Mercier, formerly deputy chief engineer of the public works department of Montreal, Canada, has been appointed chief engineer of public works of that city. He received his professional education at *L'Ecole Polytechnique* and has been engaged in active practice since 1899, principally on municipal and railway work.

W. Earl Weller, formerly acting city engineer of Schenectady, has been appointed city engineer of Binghamton, N. Y. This appointment was announced in these columns last week, but Mr. Weller's name was given as Kellar.

G. S. V. Williams, public service commissioner of the First District, New York State, has resigned from that office, to be effective Jan. 31.

Major Robert R. Raymond, in charge of the U. S. Army engineers' office in Los Angeles, is to be transferred to Honolulu, Hawaii, in February. Since his arrival in Los Angeles from Wilmington, Del., in January, 1914, Major Raymond has been in charge of the construction of fortifications at Fort MacArthur, guarding Los Angeles harbor, the estimated cost of which is approximately $4,000,000. Rapid progress has been made on this work, it is reported, and the first units of foundations for the batteries are ready for the guns that are to be delivered in the spring. Major Raymond has also taken an active part in Los Angeles harbor improvements, having recommended many important changes, including the widening and deepening of the channels.

E. R. Lewis, assistant to the general manager of the Duluth, South Shore & Atlantic Railway, will, beginning to-day, have charge of all matters pertaining to engineering, maintenance of way and structures, and federal valuation. Mr. Lewis is a native of New Jersey, and was graduated from the State University of Iowa in 1890. His early experience was acquired with the Missouri Pacific and the Omaha Southern railways, and in private practice. From 1897 to 1901 and from 1902 to 1906 he was engaged in railroad work in South Africa. Returning to the United States in 1906 he became division engineer of the Michigan Central Railroad, where he remained until 1912, when he went to the Duluth, South Shore & Atlantic as assistant to the general manager.

Obituary Notes

Thomas F. Richardson, retired civil engineer, of Rutherford, N. J., who built the cogwheel railroad to the top of Pike's Peak, died Dec. 26, 1915, at Rutherford, N. J. He was 61 years of age Mr. Richardson first engaged in engineering work with the Boston Waterworks. After this service he went to the West, where he engaged in railway location and construction. He also worked in Mexico. Returning to the East, he was for many years with the Metropolitan Waterworks in Boston. His last engineering service was as chief civil engineer for J. G. White & Company, Inc., from which office he retired about a year ago.

Col. Alexander W. Swanitz, a civil engineer, who has been engaged on the construction of the Alaska Central Railroad for the United States government, died Dec. 22 at his home in Alameda, Cal., at the age of 64.

Charles H. Sharp, vice-president of the Sharp & Fellows Contracting Company, Los Angeles, Cal., died in that city, Dec. 22, 1915, at the age of fifty-six. Mr. Sharp was engaged in the construction of railroads in practically every section of the United States, and in parts of Canada, for the last forty years. He went to the West in early manhood from Washington, D. C., and located in Kansas City. In a few years he had established himself there as a railroad contractor. Work on the Pacific Coast took him to Los Angeles six years ago, where, with C. A. Fellows, he organized the Sharp & Fellows Contracting Company. Among the large contracts executed in the Southwest by the firm were the Cajon Cut-off, across the mountains east of San Bernardino, for the Atchison, Topeka & Santa Fé Railway, and the line of the San Diego & Arizona Railroad through the mountains east of San Diego, these being two of the heaviest pieces of recent railway construction work in that section.

Civil Service Examinations

United States.—The Civil Service Commission announces an open competitive examination for civil engineers in the Philippine Service, to be held Jan. 18. The salary ranges from $1,800 to $3,000 a year. The requirements include, among other things, 3 years' training or a technical education of recognized reputation, and 2 years of responsible work in the design or construction of irrigation or water supply systems or in that of steel or concrete buildings or bridges. Applicants must be 25 years of age and not over 40 years. They must also be physically qualified to perform such duties as are required. Application should be made for form B. I. A. 2, stating the title of the examination for which it is desired. These forms may be secured from Washington, D. C., or from the civil service boards of the large cities and of the territories.

Another open competition examination announced by the Civil Service Commission is to be held Jan. 19 for sanitary engineers for the Bureau of Science, Manila, P. I., at salaries of $1,600 a year. This examination will require that applicants shall have had a college or university education in sanitary engineering or at least 4 years' experience in such work; also that applicants must be between 21 and 40 years of age and physically qualified for the work. The form for this examination is B. I. A. 2, and is secured in the same manner as that for civil engineers noted above.

Structural engineer and draftsman is the title of an examination to be held Jan. 19-20, under the supervision of the Civil Service Commission for eligibles for a position with the Supervising Architect, Treasury Department. The salary of this position is $1,800 a year. Applicants should be technically qualified as to training and should have 5 years' practical experience, two of which shall have been in either steel designing or construction work. The age minimum for taking the examination is 23 years. The duties are said to involve engineering problems of first-class building construction. The form number for this examination is 1312, and in applying it should not be forgotten to specify the title.

New York.—An examination for architectural draftsman, salary from $1,201 to $1,500 a year, is to be held Jan. 22. Candidates must have had 2 years' practical experience in architectural drafting, or, in the case of graduating from a school of satisfactory standard, one year's experience subsequent to graduation. The application blank must be in the office of the Civil Service Commission at Albany on or before Jan. 12, otherwise it will not be accepted.

November Exports Reach Large Proportions

A total trade of a half billion dollars in the month, and of five billion dollars in the year, with exports comprising two-thirds of the whole, is the unparalleled record of American commerce in November and the twelve months ending with November. Figures made public by the Bureau of Foreign and Domestic Commerce, Department of Commerce, show that November imports were valued at $164,319,169, as against $126,467,062 in November, 1914, and that they exceeded by $11,000,000 the former November record made in 1912. Twelve months' imports to Nov. 30, 1915, aggregated $1,730,243,229, as compared with $1,858,645,027 in the preceding year.

November exports broke all prior records. Last months' total was $331,144,527, as against $328,030,281 in October, 1915, also a record. The export balance for November was $166,825,358, as compared with $79,411,271 for November, 1914, and, for the twelve months ending with November last, $1,707,049,304, as against $242,542,093 one year ago and $738,472,118 two years ago.

Gold imports during November, 1915, amounted to $60,981,540, as against $7,391,729 in November, 1914. Twelve months' imports of gold aggregated $410,650,976 as compared with $58,352,035 in the preceding year. November exports of gold were valued at $3,661,153 as against $14,526,482 in November, 1914; while for twelve months ending with November the total was $19,667,557 as compared with $233,057,825 in the preceding year. Instead of a net outward gold movement of $174,705,790 as in the twelve months ending with November, 1914, the year just ended shows a net inward gold movement of $390,983,419.

Turbine Runs Almost Three Years Without Stop

After carrying a load continuously for two years and eight months, without the steam being turned off at the throttle, a 500-kw. Westinghouse Parsons turbine in the plant of the Quincy Market Cold Storage & Warehouse Company at Boston, was shut down for an inspection. Examination showed that the machine was in perfect running condition, and it was immediately started up and put into service again.

Powdered Zinc Used for Coating Structural Steel

Powdered zinc, compressed air and heat are the three elements which are used in the "Cyclone" zinc spraying apparatus for coating any exposed surface and in particular structural steel or other metals. The apparatus which has just been placed on the market, consists of a brass shell-shaped container which holds from 25 to 30 lb. of powdered zinc, and to which are attached two tubes, through one of which compressed air enters the machine, the other which serves as a carrier of the powdered zinc to the spraying nozzle. The nozzle or burner consists of two tubes, the inner tube being connected directly to the zinc supply tube. The outer tube of the nozzle is attached in turn to a gas tube. When the device is to be operated the gas is turned on and the burner lighted—either acetylene or ordinary city gas can be used. The compressed air under 25 lb. pressure is then turned on the powdered zinc, which is forced out to the tip of the nozzle where it comes in contact with the heat of the burning gas and is turned into an atomized state. When the metal strikes any object capable of sustaining the force of its impact it cools instantly and adheres.

The machine, which can be run 10 hours without refilling, is manufactured by the Metals Coating Company of America, Chicago.

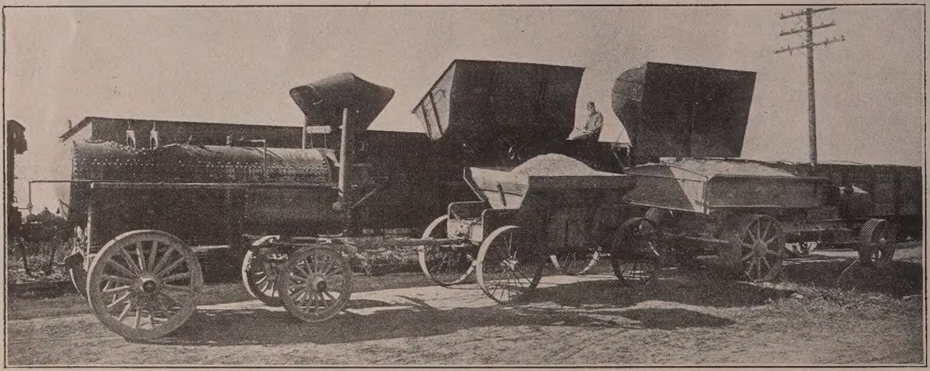
Locomotive Without Tender Adds Car to Train

A 2-6-2 locomotive with side tanks and rear oil tank that is probably one of the largest saddle-tank locomotives ever built has been recently completed for use on a switchback railway where a locomotive with a tender attached would have necessitated a lengthening of the tail tracks or the dropping of a car from the train, besides being objectionable on account of the added weight on the steep grades over which engine will operate. On account of the contour of the ground the former course would have been very expensive.

The cylinders of the locomotive are 21 in. in diameter by a 26-in. stroke. It weighs about 100 tons in working order and is equipped with the Walschaert valve gear and superheater. It will do the switching and yard work for the Inspiration Consolidated Copper Company, whose mine will have a daily capacity of 14,000 tons of ore. It was built by the H. K. Porter Company, manufacturer of steam, compressed air and gasoline locomotives of Pittsburgh.

Hauling Equipment That Proved Economical on Road Work

Fifteen teams and ten men were saved on a road contract recently carried out by Thomas Levene near Griffin, Ill., by the use of a White truck and trailer and Lee portable unloaders. In building the asphalt-penetration road, surfaced with three grades of stone, nine dump wagons, each with a team and driver, and three asphalt penetration tanks, each requiring two teams, a driver and a fireman, were in use before the truck was employed. The truck and trailer, making the 4½ mile round trip in less than an hour including stops, not only hauled as much stone as the nine teams, but also picked up the empty and full tanks as the work progressed, and made the trip from the siding to the job so quickly that firemen were not needed on the tanks. Four men, shoveling all the time into the unloaders, were able to keep the truck and trailer moving without delay.



THIS OUTFIT EFFECTED LARGE SAVING OVER TEAMS IN HAULING ROAD MATERIALS

Business Notes

The Loggers and Contractors' Machinery Company of Portland, Ore., has moved its office from 71 Fifth Street to 70 Fourth Street, Portland.

The Lehigh Portland Cement Company has purchased the Old Dominion Portland Cement Company, thereby adding 1,000,000 barrels, it is said, to its annual capacity.

The Weller Manufacturing Company, maker of conveying apparatus and grain elevator machinery, has recently occupied its new and greatly enlarged plant at 1820 to 1856 North Kostner Avenue, Chicago.

H. C. Beckwith, formerly Chicago manager of the T. L. Smith Company, manufacturer of concrete mixers and other equipment, of Milwaukee, has been appointed treasurer and general manager of the Byers Machine Company, at Ravenna, Ohio.

The Electric Steel Company, Chicago, has been organized to make small castings in that city. A Snyder electric furnace will be used. The officers of the company are: Charles Piez, president, and P. L. Coonley, secretary and treasurer, who are respectively president and vice-president of the Link-Belt Company. The active management will be in the hands of John M. Olmsted, vice-president, who has been a member of the sales force of Link-Belt Company. In order to commence operations with the least possible delay, and to offer quick delivery, the company has leased the plant at Thirty-first Street and Wood Street, formerly occupied by the Wildman Boiler Works. The location has a switch off the main line of the Chicago & Alton. Power is supplied by the Commonwealth Edison Company from its high-tension lines.

Trade Publications

The following companies have recently issued trade literature:

Foundation Company, Ltd., Montreal and Vancouver. Catalog, 11 x 8 in., 48 pages, illustrated. Foundations, substructures and subaqueous works in Canada.

Mesta Machine Company, Pittsburgh. Bulletin R, 6 x 9 in., pages 5 to 8, illustrated. The Mesta 72-in. and 84-in. barometric condensers and 14-in. and 36 x 24-in. dry-air pump.

Ball Engine Company, Erie, Pa. Bulletin S-12, 8½ x 11 in., 12 pages, illustrated. Describes Erie revolving shovels and their operation, the illustrations showing them at work on various jobs.

Bruno, Grosche & Company, 90 Wall Street, New York. Catalog, 6 x 9 in., 24 pages, illustrated. Treats of wood preserving oils and coal tar products. Describes S. P. F. Carbolineum and its effect on timber. The illustrations show various buildings and structures in which Carbolineum has been used.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Special Publication 1562, "Railway Equipments and Locomotives in the War West," 8½ x 11 in., 48 pages, illustrated. An ornate booklet describing by text and picture numerous installations of this company in and beyond the Rockies.

Ruggles Machine Company, Poultney, Vt. Catalog, 7 x 10 in., 64 pages, illustrated. Describes quarrying and stone-finishing machinery, including the Ruggles aerial, automatic carrier and cableway, which has also been used in the construction of dams, canals, etc., and excavations of all kinds. Its simplicity of construction and operation is one of the advantages claimed for it in work of this nature.

Pelton Water Wheel Company, San Francisco and New York City. Three folders; 10¾ x 7¾ in.; 4 pages, illustrated. Describes Pelton waterwheels for small power developments in remote districts and illustrates the various uses to which they may be put, in English, Spanish and Portuguese. Gives instructions for measurements to be made so company may advise in regard to type of wheel best suited to meet the requirements. It is an attractively prepared booklet and should prove very useful.

James B. Clow & Sons, Chicago. Catalog, 9 x 12 in., 54 pages. The book is devoted primarily to plumbing fixtures, but is written along new lines. It is entitled "Wasting a Million a Day," and aims to interest the executives of big corporations in the problem of water waste. It is very effectively gotten up and even the busy executive will be willing to stop long enough to go through it. The waste in leaky faucets, and in improperly designed flush-tanks and fixtures of other classes is clearly brought out. Of direct value to engineers are data on cast-iron pipe and the various types of valves made by the company.

Berger Manufacturing Company, Canton, Ohio. Catalog, 8½ x 10¾ in., 30 pages, illustrated. Confines itself entirely to fire resistant tests of Berger metal lumber pressed steel construction, made officially and unofficially, and their results. Takes up the subject in the form of reports and treats each test separately, considering the method of the test, the test itself and the various results. Photographic reproductions of the tests before and after and temperature and deflection charts are included in the text. Interesting facts are indicated in the charts. These various tests have to do with floor, wall and roof construction, the floor test being made as well under loading conditions. Summarizing the results of the tests the last page of the book enumerates the reasons for such results.

Allis - Chalmers Manufacturing Company Milwaukee. Bulletin 1636, 7¾ x 10½ in., 56 pages, illustrated. This booklet is intended to show the range of manufacture of Allis-Chalmers hydraulic turbines and accessories, hydroelectric units of the vertical and of the horizontal shaft types and recent large installations of units placed under one contract by this company for hydroelectric plants. In the text, besides the general descriptions of Francis and impulse type turbines, governors and auxiliaries and accessories are discussions on unit efficiency, selection of types and turbines and power house tests. The illustrations, showing recent installations of Allis-Chalmers machinery, are unique in the fact that each photographic reproduction is accompanied with plan and elevation drawings, and, invariably, cross-sections. In this manner a clear idea is obtained of the unit. Other illustrations are presented picturing the various pieces of machinery, and are accompanied by description and specifications which explain the parts in detail.

Wellman-Seaver-Morgan Company, Cleveland, Ohio. Catalog, 8½ x 11 in., 100 pages. This is a catalog of unusual character. The introduction points out that the development of hydraulic-turbine building in the United States in the last ten years has been phenomenal—and the book very appropriately pictures and describes much of the best of this development. The typography and arrangement of the book accord with the importance of the subject. An introductory chapter on turbine characteristics states briefly but clearly the important performance features of modern types of wheels. Then follows a brief discussion of plant design, and then a very thorough treatment of details of construction, which contains much of value to the hydraulic engineer. A chapter is devoted to the Johnson hydraulic valve and thereafter are descriptions of some of the great installations in which Wellman-Seaver-Morgan wheels have been used—the Keokuk plant, the Ontario Power Company's plant at Niagara Falls, the Cedar Rapids plant on the St. Lawrence, the Salmon River Power Company's installation and several smaller plants. All in all, the book is one that the hydraulic engineer will be glad to have on his shelves.